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A WANTON STRIKE.

We are heartily glad to see how resolutely the Interborough system has grappled with the wanton strike of its operating force. These men through the union were under written and signed contract to stand by the existing wage scale till 1907, yet inside of three months have thrown contract and honor to the winds, alleging a few puerile and flimsy grievances which even if they existed would not warrant the intolerable inconvenience inflicted on the public. Besides, at worst there was arbitration to appeal to as a means of settlement. But nothing would serve except a swift and sudden strike—and that has already failed. On the first day of the strike the Interborough system carried 400,000 passengers, and to-day as we write—Wednesday—things are quickly and quietly settling down to the normal. The rate of pay is such as to attract intelligent men, the duties are not heavy, and the work is not a tax upon either brain or muscle. Believing as we do in the organization of labor, we are pleased to note that its leaders disapprove of this action by a pampered body of men, who had been spoiled by previous weakness in the way of yielding to unjustifiable demands. This is the foolish kind of performance that does so much to discredit the union idea.

JAPANESE PURCHASES OF LAMPS.

The present Russo-Japanese war has been terribly destructive of all kinds of material, and must involve enormous purchases for renewal by both countries. Meantime, it is remarkable how general and large is the present demand from Japan for machinery and electrical supplies, and these by no means directly connected with the war. In fact, Japan appears to be enjoying great commercial and industrial activity, and our columns have made frequent note recently of large orders and contracts. It had been supposed and may still be possible that Japan would do a good deal of her own electrical manufacturing; but the fact remains that she buys such electrical apparatus abroad and quite heavily in this country. For example, we noted last week one single order for a leading make of incandescent lamps, to the tune of 100,000. Not only are the lamp makers who secured such an order to be congratulated, but in view of the foreign competition for the market there is given evidence of a faith in standard American product that is very gratifying. And this order was but typical of those in other lines.

MOVING SIDEWALKS.

New Yorkers now have available so many kinds of transportation the absence or the addition of one or two makes no great difference. Even with the Subway and the Elevated "tied up" by strike, they manage to get to and from business, subject to vexatious delay, of course, but they get there just the same, by surface car, electric automobile, hack and hansom, not forgetting the useful but now plebeian bicycle. Hence, the fact that yet another means of transportation is offered does not attract the attention it deserves. The Board of Rapid Transit Commissioners have now adopted as part of their scheme of subway extension a plan for moving sidewalks; and these it is proposed to install on Thirty-fourth Street.

It will be very interesting to see some such enterprise carried out, not because it means more work for electricity to do, but because it promises great public convenience. Those of us who have used the moving sidewalks at Chicago in 1893 and Paris in 1900 do not

need to be told that the device works. At Chicago the sidewalk was away off by Lake Michigan and did not serve any purpose of great utility, but at the Paris Exposition it proved a most admirable means of getting quickly from point to point. Its carrying capacity was enormous, its two rates of speed were most advantageous, and the current consumption was extraordinarily low. For New York it has been estimated that on the sidewalk one horse-power-hour will do as much work as 8 hp on the Elevated and 13 hp on the Subway. We think these figures of difference are exaggerated, but there is no question about the intrinsic economy of operation. We should greatly like to see this moving sidewalk installed and tried out in New York, as the first real example for street traffic in the world. Moving stairways have already been given a successful trial here, but the moving sidewalk has in it the potential capacity of infinitely greater usefulness. The sidewalk designed for Thirty-fourth Street is estimated to have an ability to deliver at any given point no fewer than 47,500 seated passengers per hour. Seats are a good feature, but not an absolute necessity for any kind of "sidewalk" or "platform."

ACCURATE METERS.

Comptroller Grout, of New York City, finds a great many ways of setting himself down as an ignoramus when he discusses technical and scientific subjects. He allows political ambitions to carry him in his attacks on public service corporations far beyond any rhyme or reason. Endeavoring lately to justify his Kuropatkin campaign against the electric lighting companies by attacking the accuracy of the meters, some of his remarks in this respect are very funny, and they gain neither in weight nor force by the prominence given them in newspapers that try to make common cause with him.

We take this opportunity to note publicly the fact that the meter department of the New York Edison Company has the well-earned reputation of being one of the best in the world—well-organized, well-conducted, liberally and carefully managed. In fact, the company stands sponsor in a degree for the testing laboratories in this city which we described recently at great length and which are regarded most highly in all technical circles for the precision and exactitude of their work. Mr. John W. Lieb, of the New York Edison Company, has brought the work to a high standard, and it is simply outrageous that an ignoramus like Mr. Grout should vent the arrant nonsense he does when the most conscientious effort is being put forth to maintain the highest standards of truth and accuracy in meter practice.

The New York Edison Company will have no trouble in convincing the most exacting customer who is ready to recognize the facts without prejudice, and can cope with this situation if fairness is allowed to rule. Moreover, the meter manufacturers will have something to say when their product is so baselessly slandered. We know, however, what the popular attitude often is in such matters, rendering it easy for a politician of the Grout stripe to play on it. As Prof. Elihu Thomson says, himself the distinguished inventor of the meter most in use in this city and probably the best known all over the country: "There seems to be an element in human nature which, whenever the subject of meters is up for discussion, be they for water, gas or electricity, and no matter what degree of accuracy may be attained, leads to condemnation of these valuable instruments. It doesn't seem to be so much a question of accuracy, which can easily be determined by simple tests, as the feeling of distrust which exists in the minds of many uninformed people." This is true and well put, but there lies in it no justification for Mr. Grout, who can ascertain in five minutes from any electrical expert in the city employ the truth and righteousness of our protest against his loose and empty charges and inuendoes.

RECORDS OF ALTERNATING CURRENT WAVES.

Mr. Ernst Ruhmer, of Berlin, has recently described in the *Electrotechnische Zeitschrift* an interesting observation on a certain property of Geissler tubes. When such tubes with straight-wire electrodes are suitably excited, the cathode glows with an intensity depending upon the strength of the excitation. Consequently, when the appearance of the tube is examined in a darkened room and with the aid of a revolving mirror, the appearance presented gives the characteristic wave form of the alternating voltage. It is not easy to present an area diagram of alternating-current waves. The ordinary oscillographic methods give outlines of the waves, and indeed it is the outline which is usually desired. This method, however, gives the complete surface areas of the successive waves, as distinguished from the outline. The apparatus seems likely to possess useful applications for special purposes.

A very crude but relatively simple method which has been occasionally used for presenting the appearance of alternating-current waves in shaded areas, is by a special use of the Bain electrochemical recorder. In place of the single steel needle of this well-known recorder, a number of parallel steel needles are laid side by side, so as all to press continuously upon different points of a moving band of chemically sensitive paper. The steel wires are all insulated from each other. Half of them are made incoming terminals and the other half outgoing terminals. Under these conditions, if connected in an alternating-current circuit, there would be left the electrochemical record of the alternating waves in blue shaded areas of rectangular form. The wave form would be rectangular, no matter what the actual wave type of the alternating current. By grading the strength of each needle successively, so that the internal needles have no extra resistance in their circuits, but the succeeding outside needles have more and more resistance, it is possible to get the outside needles to record only at the peaks of the waves, while the others record at intermediate voltages. By this means a picture can readily be made of the real wave form of voltage in its rough outlines.

AN EUROPEAN SINGLE-PHASE RAILWAY.

It is a bit exasperating to find the first engineering data from a single-phase railway in actual operation coming from the Tyrol. The Stubai Valley road, to which we refer, and of which brief mention is made in the Digest, has been in operation since about the first of last August. It is not a long line, only about a dozen miles, but it has some long and stiff grades, rising more than 1,200 ft. in the first six miles. The track is of one meter gauge, laid with rail weighing a scant 40 pounds per yard. The power is transmitted at 10,000 volts, 42 cycles, and is reduced to 2,500 volts for the trolley wire, which is approximately No. 0 B. & S. gauge, suspended about 18 ft. above the track from a steel bearer cable carried by insulators fixed on rigid cross-suspension bars. The motor cars for this interesting system are equipped with four 40-hp Winter-Eichberg single-phase motors, connected as two pairs in parallel, and draw one or two trailers, the normal speed of the trains being about 15 miles per hour. Some light freight cars are also included in the equipment. It will thus be seen that this initial single-phase system is a typical light road in a mountainous country, neither exceptionally difficult nor yet unduly easy. On the whole, it strikes one as a case well adapted to try out a new system very effectively.

From an operative standpoint it is reported as successful. If there have been difficulties with the motors they have not been of for-

bidding magnitude, and the general situation as thus disclosed looks promising. From the first four months of operation, day in and day out, the energy measured at the car was 70 watt-hours per ton-kilometer. The corresponding output determined from careful estimation of the train resistances was 48 watt-hours per ton-kilometer, so that the apparent efficiency of the car equipment was 68 per cent., which is not at all bad under the circumstances. Altogether the impression left by this first report is a rather favorable one. Of course, this Tyrolean road may actually be less promising than it seems. All sorts of trouble may have been found in the commutation, and the scrap heap, if it could be seen, might tell a sorrowful tale; but the road has been for some months in commercial service and there is every reason to believe that it will keep on and give a reasonably good account of itself.

It is interesting to note the relatively high frequency adopted in this case. On this side of the water nothing higher than 25 cycles has been considered, and even that has been regarded as higher than would be really desirable. Of course, high frequency is a handicap in motors of the sort under discussion, but the fact that the first single-phase line is commercially operating at 42 cycles should furnish food for reflection. There are not a few instances in this country where railways are in situations for which the alternating system would be well adapted, but there seems to be a sort of silent pressure opposing its use. It is perfectly true that some engineers strongly recommend its use in "appropriate situations," but for the most part they are precious careful to find that a given situation with which they are confronted is not appropriate, and is upon the whole advisable to treat along "standard" lines. Meanwhile the foreigners are going ahead and putting in alternating roads, single-phase and polyphase, and seem to find little difficulty in securing appropriate situations. What is going to be the end of it all? Unless the very capable Continental engineers who have been working on alternating-current traction are quite mistaken and rash in their judgments—a conclusion which experience does not warrant us in assuming—some fine day we shall suddenly wake up to find a huge contract gone by default to these same rash foreigners. If the alternating railway motor is really a good thing we cannot afford to dodge it. If it is not a good thing some of the laudatory articles about it will make very amusing reading a few years hence. In either event the present situation is somewhat embarrassing.

THE CARRYING CAPACITY OF MULTIPLE CABLES.

It is well known that the carrying capacity of such cables as are employed in electric lighting depends upon their temperature elevation under load. The insulating material must not be allowed to exceed a certain safe limiting temperature under any circumstances. These cables usually contain a central cylindric copper conductor, or strand of conductors, and an external leaden sheath. When the temperature of the external sheath is fixed by its environment, as for example, when the cable lies in a river or lake, the temperature elevation of the copper conductor will depend only upon the dimensions of the cross-section, the nature of the insulator, and the strength of the current carried. The limiting current, or carrying capacity of the cable, should be that which will finally bring the temperature of the conductor to the safe limiting temperature. The simplest method of computing the temperature elevation attained by a given cable conductor, carrying a given current, is known to be the method of thermal resistance. The insulator not only possesses electric resistance, but also possesses thermal resistance, or resistance to the radial flow of heat. Moreover, the laws of thermal resistance are almost precisely analogous to those of electric resistance. A difference of temperature of one degree centigrade between the conductor and sheath will send one thermal ampere through one thermal ohm. The case is, therefore, one of Ohm's law applied to thermal conduction. The thermal amperes are known, because they are equal to the I^2R joules produced in each second by the current strength, I, passing through unit length of the conductor having the known electric resistance, R.

The dimensions of the insulating cylinder determine its thermal ohms, when the thermal resistivity of the insulating material has been found by previous measurement. Consequently, the thermal volts, or difference of temperature, in degrees Centigrade which will send this constant thermal current through the resistance of the insulator may be readily found. Conversely, the limiting value of temperature difference, or thermal volts, and the thermal resistance of the insulator, determine the limiting I^2R and I. When the cable is buried in the soil, or is laid in a conduit, the matter is rendered more complex, because the temperature of the sheath is no longer definitely fixed and reduced by its environment to that of the normal soil. In other words, there is usually considerable thermal resistance in the soil outside the cable as well as thermal resistance in the insulator inside the cable. The heat flow, or thermal amperes, must traverse these two resistances in series and raise the temperature of the internal copper conductor by the extra drop of temperature in the soil resistance. This makes the carrying capacity of the cable lower when placed in a conduit than when submerged in a river. However, the thermal resistance of the soil may be either computed or estimated, and the safe-carrying capacity of the cable assigned partly by experience, partly by previous measurements, partly by computation and partly by guesswork. The greater the experience, the surer the computation and the less the guesswork, the better for all concerned. When, moreover, the cable contains several insulated conductors, or is a multiple cable, the matter is complicated by the awkward geometrical relations of conductor, insulator and sheath presented by the cable's cross-section. The thermal resistance of the insulator is no longer capable of being computed by the simple formulas applicable to single-conductor cables.

The problem of the thermal resistance of multiple-conductor cables has recently been excellently treated by Mr. Gustav Mie in the *Elektrotechnische Zeitschrift*. In the article referred to, the copper conductors of a multiple cable are, for convenience, slightly distorted in form on their inner sides, retaining their true cross-sections and resistances, in order to simplify the computation without serious loss of accuracy. On this assumption the problem is first rigidly solved, and then an approximative engineering formula is given for practical use. The multiple conductors are reduced to an equivalent single conductor. The radius of this equivalent single conductor is equal to the largest radius to which conductors extend in the cross-section; i. e., to the greatest radius, multiplied by a reducing factor. This factor is the nth root of a fraction, n being the number of conductors. The fraction has for its numerator the sum of all the radii of the individual conductors, as measured from their own axes. The denominator of the fraction is this sum, less one radius, but increased instead by the minimum radius from the center of the cable; that is, the radius from the cable axis to the nearest copper. The internal cable radius is thus substituted for one conductor radius in the denominator sum. The advantage of this solution is that it not only applies to the thermal problem, but also to the corresponding magnetic, electrodynamic, electrostatic and hydrodynamic problems. Thus, the electrostatic capacity of a multiple-wire cable is determined, with all the conductors bunched as one electrode, the sheath as the other. Such is the close interrelation between natural phenomena and the wide domain of mathematical law.

Street Railways in Connecticut.

The annual report of the Railroad Commissioners of Connecticut shows that there is a total of 669.334 miles of main tracks within the borders of that State; length of sidings and turnouts, 31.521 miles, making a grand total, computed as single track, of 700.855 miles. The three companies controlling the greatest mileage of main tracks are the Consolidated Railway Company, representing 181.805 miles; the Connecticut Railway & Lighting Company, 168.269 miles, and the Hartford Street Railway Company, 86.868 miles, leaving 242.392 miles operated by the other companies, although some of these companies are owned by the three first-named, but are reported under a separate management.

The total capital stock of the companies, outstanding, is $30,659,748, representing 631.825 miles of street railway owned; also, in some instances, gas and electric properties.

The total bonded debt of the street railway companies is $22,207,342.27, and, like the stock, covers not only street railway, but also gas and electric light properties. These bonds cover only 610.620 miles of the roads owned, showing an average bonded indebtedness of $36,380.43 per mile on the roads so covered. The floating indebtedness of the companies is $2,540,189.30, and the total stock, bonds and floating indebtedness, $55,407,279.57.

The cost of construction and equipment reported is $55,575,086.57, which also includes the cost of the street railways and gas and electric light properties.

The gross earnings for the past year have been $4,924,151.46, being $420,580.17 more than for the preceding year. The gross earnings per mile operated were $7,187.20, and per mile run $0.2164. The number of miles operated were 685.128. The gross earnings per car hour were $3.23.

The operating expenses for the year were $3,287,113.55, being $122,514.48 more than for the previous year, and are $4,797.81 per mile operated and $0.1445 per mile run. The expenses were 66.75 per cent. of the gross earnings. The net earnings for the year were $1,637,037.91, as compared with $1,338,972.22 for the preceding year, and were $2,389.39 per mile operated and $0.0719 per mile run.

Eight companies have paid $120,050 in dividends upon capital stock amounting to $1,900,000, while no dividends are reported as paid on $28,759,748 of capital stock. This is $249,766.24 less than the amount paid last year, arising principally from the fact that none are reported as paid by the Fair Haven & Westville and Winchester Avenue Railroad Companies, which last year amounted to $245,486.24. The sum of $876,658.99 in interest has been paid on a total bonded and floating indebtedness amounting to $24,747,531.57.

Number of miles run, 22,750,560. The gross earnings per mile run have been $0.2164, operating expenses $0.1445, and net earnings $0.0719. The number of miles run, as reported, was 1,720,671 more than last year; the gross and net earnings per mile run slightly more and the operating expenses slightly less. The number of fare passengers carried were 93,111,402, compared with 96,857,782 last year, a decrease of 3,746,380, contrasted with 64,315,374 carried by the steam railroads, which number was also a decrease of 603,098 in the number carried the previous year.

Ohio Independent Telephone Delegates.

Representatives of 160 independent telephone exchanges, included in the Fourth and Ninth Ohio districts, met at the Hartman hotel, Columbus, O., March 1. Dwight E. Sapp, of Mt. Vernon, presided.

Frank L. Beam, of Columbus, gave a report of the business of the independents, compared with that of the Central Union, in the two districts, as follows:

	Ind.	C. U.
Exchanges	160	28
Toll stations	360	132
Subscribers	43,923	15,078
Stockholders	1,575	.....

G. P. Thorpe, of Wilmington, vice-president for the Fourth district, was re-elected, and Dwight E. Sapp, vice-president for the Ninth district, was also re-elected. For delegates to the national convention, to be held in Chicago, June 20 and 21, G. P. Thorpe was elected from the Fourth district, with Joseph I. McKell, of Chillicothe, as alternate; from the Ninth district, E. J. Grosscup, of Ashland, is the delegate, and S. E. Ward, Mansfield, alternate.

The State convention will be held in Columbus, March 30, delegates to which were selected to represent both districts.

Telephonic Development in Canada.

The statement issued at the twenty-fifth annual meeting of the Bell Telephone Company, of Canada, just issued, shows that the company now operates 475 exchanges and 789 agencies, with 66,160 sets of instruments earning revenue. During the year 1904, 8,988 new subscribers were gained, and 1,242 miles of wire added to the long-distance system, which now comprises 32,211 miles of wire on 7,866 miles of poles. The report says: "2,000 shares of new stock were offered to the shareholders at 25 per cent. premium, with the option of paying for them in full or in quarterly instalments; 16,845 shares were paid up in full. The amount of $1,916,960 has been received during the year on account of stock, and $479,240 for premium thereon. The latter amount, in accordance with our usual custom, has been carried to the contingent account. From the balance of revenue, $154,323.96, $35,565.26 have been carried to insurance reserve account; $23,958.25 to accident insurance reserve account and $50,000 to contingent account, leaving a balance of revenue to be carried to 1905, $44,800.45." The total receipts for the year amounted to $2,838,000, the expenses including bond interest, etc., totalled $2,231,000. The net revenue for 1904 was $701,000. Of this sum the dividends took $588,000, leaving the sum of $113,000, which was carried to reserve, accident and contingent account. The latter account, with the additions of $479,000 premium on stock, and $50,000 added to it this last year, now amounts to $1,845,000.

The president, Mr. C. F. Sise, gave statistics relative to the growth of the corporation. "Twenty-five years ago," he said, "the company began business in Canada, with a capital of $397,000. To-day the capital is just a trifle short of eight millions in stock, and the bond issue $2,000,000. In 1885 the long-distance mileage amounted to 2,000 miles; to-day it is 32,000 miles; ten years ago there were 69,000,000 exchange connections during the twelve months, now there are 228,000,000 during the same period. Ten years ago the subscribers throughout Canada numbered 29,000; to-day there are 66,000 instruments earning rental."

Referring to competition, Mr. Sise said the Bell Company did not suffer on that score, appreciably. There were many small concerns in the business, but none of them were paying dividends. In the neighborhood of Quebec were a number of small corporations, which had extended lines into the rural districts; they were more of a convenience to the farmer than a commercial enterprise. As regards the "Merchants," in Montreal, they served a class of customers, who did not care to pay the price for the Bell service. At the present some thirty municipalities in Canada have given the Bell Company exclusive rights.

Meeting of the American Institute of Electrical Engineers at Chicago

The regular meeting of the Chicago branch of the American Institute of Electrical Engineers was held in the rooms of the Western Society of Engineers, in the Monadnock Building, Tuesday evening, February 28. The first paper on the programme was presented by Mr. E. B. Clark, assistant general superintendent of the Illinois Steel Company, entitled, "The Use of Cement in Central Station Construction." It dealt with the several novel uses to which cement has been put in the construction of the new central station recently erected at the Chicago plant of the Illinois Steel Company. Features of the paper were discussed by Messrs. Bergquist, Sessions, Warder and others.

"Some Notes on the Maintenance of Underground Structures" was the subject of a paper read by Mr. John M. Humiston. The paper dealt especially with peculiar features encountered in the construction of underground cable ducts. Messrs. Carleton, Miller and others were prominent in the discussion which followed.

New York Electrical Society.

The 249th meeting of the New York Electrical Society will be held at 19 West Forty-fourth Street, New York, at 8 p.m., March 15. Dr. E. F. Roeber, editor of *Electrochemical and Metallurgical Industry*, will lecture on "Recent Developments in the Electrometallurgy of Iron and Steel." The meeting will also be addressed by Dr. Paul L. T. Héroult, of La Praz, France, on "Making and Refining Steel in the Electric Furnace."

Inaugural Electrical Decorations at Washington.

The exercises attendant on the inauguration of President Roosevelt in Washington on March 4 were accompanied by a lavish display of electrical decorations and illuminations at night. These came to a climax at the Pension Building, where the great inaugural ball was given.

The great court of the building, shown in Fig. 1, is 310 ft. long and 110 ft. wide. The roof is partly supported by the great columns

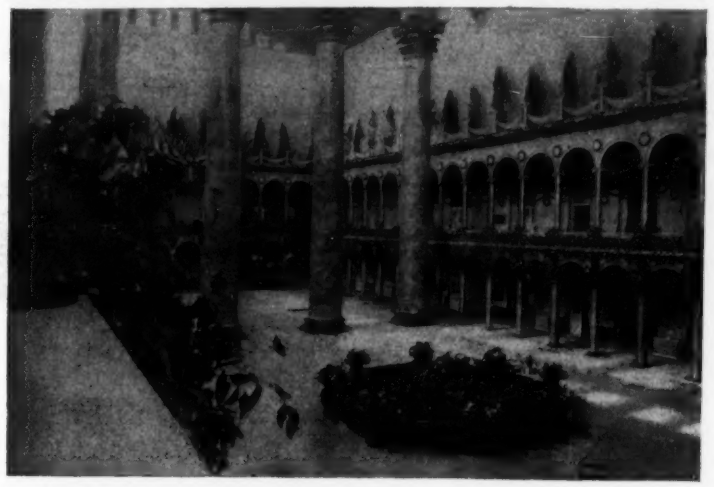


FIG. 1.—GENERAL VIEW OF BALL ROOM.

which are so prominent at the left. Another row of similar columns occupies a corresponding position at the other end of the court. Running around this court are balconies 10 ft. wide which furnish access to the rooms used for offices. In the center is a large fountain.

Amid the soft, mellow glow of the 14,000 frosted lamps, and the palms and potted flowers from Porto Rico and the Philippines, it did not require much of a stretch of the imagination to compare the scene to a summer sunset in the tropics. In a hall of such giant proportions nothing but the lavish use of electricity could accomplish so perfectly the effects desired. The last electric illumination was unquestionably excellent, and the only fault found was the glare of the light from plain lamps. On this occasion for illuminating purposes only frosted lamps were used, while a few small Christmas tree lamps were scattered through the foliage and festoons for other effects.

Current was taken by connecting with the lighting mains of the local electric light and power company. Three sets of 500,000 cm. underground cables were used for bringing the Edison three-wire system into the building. Each set was utilized independently, supplied at its own switchboard with the necessary switches and wattmeters. One main was carried to the first floor for the lights on that floor and the face of the first balcony. The other two mains were brought to the second floor, one carrying the current for the lamps on the face of the second balcony and the other supplying the 4,000 lamps in the nimbus.

Insulated feeders were run around each balcony, and at intervals of 20 ft. double branch plug cut-outs were installed for circuits of 5 to 10 amps. On the face of the first balcony were two rows of frosted lamps in six-inch pagoda reflectors set six inches apart. The line of the top row was three inches from the bottom row and the lamps in this row were set half-way between those in the row below. In each row the lamps were placed so that the tips pointed to the eye of a person one-fourth, and half-way across the court, respectively.

The arcade of the first floor was hung with streamers of green foliage caught up at arch centers, and from the same point were suspended baskets of growing white flowers. All through these streamers were worked the wires which carried the current for the 3,000 1-cp Christmas tree lamps. The arcade of the second balcony was treated differently, being hung with red bunting and lamps in pagoda reflectors set at an angle to light it up. On the cornice on the face of the second balcony was a single row of white frosted 4-cp lamps without reflectors. Below this row of lamps and directly over each pillar were arranged in 18-in. circles fifty white and yellow tinted frosted lamps. In this construction Elblight cable and sign base lamps were used.

The pièce de résistance was the electric shell or nimbus at the extreme end of the court facing the President's stand, directly back of the orchestra and choir stand, and immediately over the sounding board. It measured 50 ft. from base to tip and was 30 ft. across the base. About 4,000 lamps were used upon it. The frame was built up of ½-in. by 3-in. white pine bent to shape, and built up to a thickness of 3 in., the whole well braced at the back. The smaller arch was 10 ft. shorter and 10 ft. narrower. The two arches were secured together by ⅝ by 1½-in. strap iron, so bent as to produce the shell effect. The smaller arch was set back of the larger just two feet. Ordinary 2-in. mesh chicken wire was stretched between the two arches and formed the base on which the Elblight cables were woven.

Thirteen medallions of six lights each arranged with a central lamp bordered by five others to make a five-pointed star were secured as shown, on this netting. These lights were blue, dipped, and part of the coloring was removed, giving a slight bluish tint to the light and presenting a very pretty effect in contrast with the various shades of yellow of the lamps forming the borders for the medallions.

The face of the outer arch was studded with a double row of 4-cp white frosted lamps. Six inches from this border on the concave of the shell was another row of white frosted lamps also closely spaced. The borders of the figures which surrounded each medallion were composed of double rows of yellow frosted lamps. These were so arranged that the shades of yellow were deeper and deeper till they reached the border of the top medallion, which there presented a very deep golden tint.

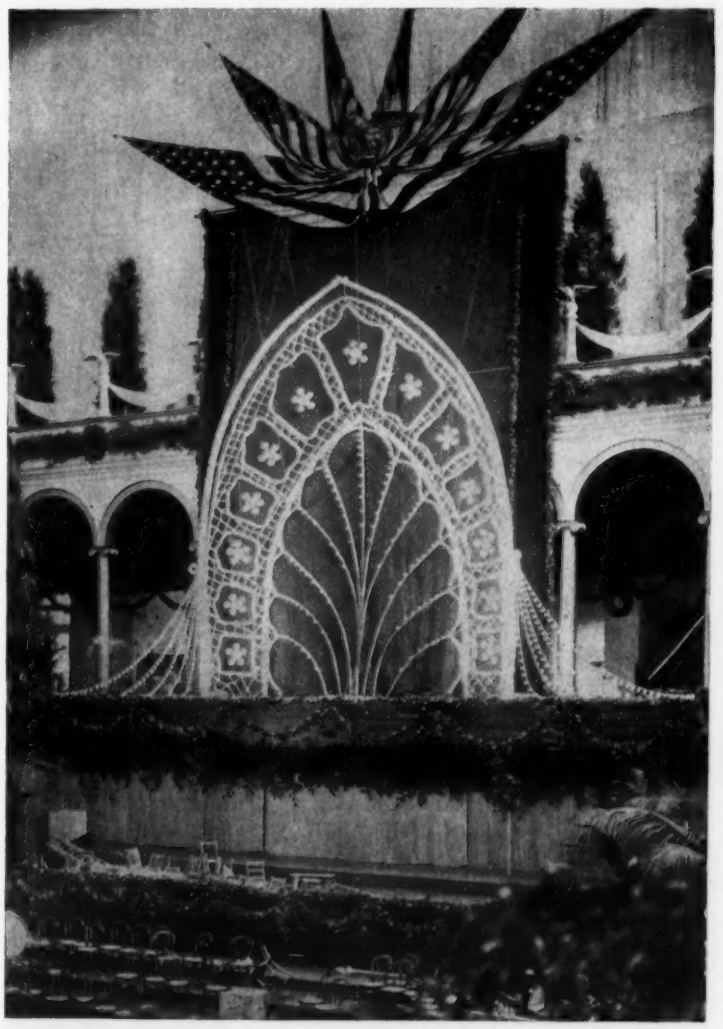


FIG. 2.—ELECTRIC SHELL OR NIMBUS.

The curved fan-like part of the nimbus was made up of green Elblight cable with white opal lamps. The only reflectors used in this construction were the 6-in. pagodas for the lamps in the medallions. The large network shown in the view was made by weaving yellow cable in the wire netting. The five streamers on each side were composed of green Elblight cable and white opal lights. On these streamers and the curved lines of the central portion of the shell the lamps were spaced so as to increase gradually the dis-

tance as the lines ran upward. The background was a very deep blue with red borders. Surmounting this background was a trophy of large American flags with a gilded eagle clutching the flags at the point from which they were caught together.

The President's room and those of the members of his official family were lavishly and elaborately decorated with foliage and growing and cut flowers. The electric display in these rooms was not elaborate, the main display being in the ballroom proper.

The electrical work was done by the National Electrical Supply Company, of Washington, D. C., and the floral work by J. H. Small & Sons, of New York.

A Proposed State Electrical Commission.

Regulation seems to be the order of the day. Regulation of New York State telephone companies and their rates, and of electric lighting, gas and all other corporations holding franchises to use the streets of any city for the purpose of furnishing gas or electricity for light, heat or power, is provided for in a bill introduced in the Assembly by E. A. Merritt, Jr., of St. Lawrence. Mr. Merritt's bill makes the State Board of Tax Commissioners a State commission of gas and electricity. Among the powers of this commission under the bill is that of "general supervision of all telephone corporations, organized and transacting business in this State under any general or special law of this or any other State or country."

The bill is very elaborate, and is by far the most important attempt to regulate telephone, gas and lighting companies that has been made in the Legislature. Authority is conferred on the commission to inform itself as to the methods employed by all corporations under its supervision in the transaction of their business, and to see that their property and franchises are maintained and operated for the security and accommodation of the public and in compliance with the laws. It may investigate the quality of gas, scrutinize the methods used in supplying gas and electricity for light, heat and power, and recommend improvements. It may name the standard of gas and prescribe the method of keeping books and making annual reports. No new telephone, gas or electric company can do business in the State unless it has the approval of the commission, and all corporations now in existence must obtain certificates of authority from the commission.

Similar approval is required for all issues of stocks or bonds, and for transfers of franchises or property. Corporations to which approval is refused are permitted to appeal to the Appellate Division of the Supreme Court.

On the complaint to the local authorities of any municipality of 300 subscribers of a telephone company in cities of the first class, and of a proportionately less number in smaller cities, "as to the rental price for the use of telephones in such city, village or town, the commission shall investigate as to the causes for such complaint and may, by its agents or employees, inspect the system and methods of the corporation complained of," and may examine its books and accounts and question witnesses.

Similar powers are conferred when complaint is made of gas or electric companies, after a public hearing and the examination of evidence. The commission may "determine the maximum rentals to be charged for the use of telephones in such municipality" or regulate the price of gas or electricity. The corporations may appeal to the Appellate Division from any decision. Violation of the decisions of the commission is made a misdemeanor.

Lectures at the Brooklyn Polytechnic.

The second of Prof. T. D. Lockwood's eight two-hour lectures on "Telephony, Telegraphy and Patent Practice," was presented on February 21 before the evening classes in electrical engineering instituted this season by the Brooklyn Polytechnic Institute. This talk was devoted to telephone and cable lines, and although the lecturer said that he was presenting a dry subject, his audience showed by its careful attention that it did not agree with him in this opinion. Prof. Lockwood brought out in a very interesting manner the chief peculiarities that have made the telephone so distinct a branch of electrical work; as for instance, the surprising smallness and high alternations of telephone currents, the marvelous sensitiveness of the telephone receiver, the susceptibility of the telephone to outside currents, the double use of telephone circuits for talking and signaling; the multiplicity of lines and the necessity of massing them into a small compass, etc. In addition he discussed the construction of overhead and underground telephone cable lines, transposition of lines to avoid inductive effects, different types of conduit, Pupin's improvements in long-distance telephony, protective devices, and the superiority of copper over iron wire. A number of practical problems were also given out.

Prof. Perrine's lecture on complete watershed and waterflow investigation was given February 23. He outlined carefully the steps which must be taken by the consulting engineer in determining the value of a hydro-electric enterprise, even giving his hearers the sources where they could obtain the most reliable data. The lecture was divided under the following heads: I, Watershed defined. II, Methods of investigation; (*a*) rainfall, (*b*) basin or area of territory, (*c*) gauging. III, The problems; (*a*) net average, (*b*) maximum and minimum—rate of change, (*c*) effect of storage. IV, Rainfall (*a*) at the locality, (*b*) government records. V, Run-off, (*a*) total holds a relation to rainfall, (*b*) depends upon locality. VI, Approximation of flow based on area of watershed. VII, gauging. VIII, Waterflow and probable load to be compared in curves. IX, Deduced curves.

Prof. Perrine also gave out a number of problems involving a study of various watersheds and the possibility of using the power that could be developed in the assigned district.

Failure of Municipal Ownership in Australia.

Special correspondence to the New York *Herald* from Sydney, New South Wales, discussing the dire effects in Australia of governmental and municipal ownership says: "The people of Australia are just now performing a variety of national experiments that are involving an expenditure of millions of money, a stupendous loss of human energy and enterprise, the laying idle of a huge fertile territory and the destruction of some of their finest and most indigenous industries and enterprises, which now stand waiting in despair to be relieved of the incubus that has been laid upon them by a veritable network of legislative restrictions worthy, and only worthy, of the Middle Ages.

"If these social, commercial and industrial experiments had never been tried and had never failed in the world's history the Australian people might perhaps be justified in calling upon the civilized world not only to contribute toward the expense of trying them to-day, but also in asking the people of those countries that thus paid their shares to study with interest the results, in order that they, too, might profit by the lessons and be able to avoid the deplorable consequences that the work of the laboratory had revealed.

"But it is all old, even ancient, matter—a veritable rehash, involving theories and nostrums that have been tried and exploded as far back as the time of Aristotle, and again revived, and again exploded, in later days, in the North American States by the colonies of disciples of Fourier, St. Simon, Lassalle and Karl Marx, who migrated from Europe to put into practice their Utopian theories; so that no one who can and will read for himself need contribute anything but pathetic laughter to so vain a series of experiments as those of the Australian people.

"Australia is, therefore, carrying on all this experimental work in the very teeth of history and of the teachings of the present generation, in some cases even within or near her own territory."

The effect of the restriction of individual enterprise is described as deadly and disastrous to the last degree. The worst drought does not compare with it.

The Volta Bureau.

In his interesting article about Prof. Alexander Graham Bell, already noted in these pages, Mr. Fred De Land says: "France awarded the Volta prize of 50,000 francs to Dr. Bell for his invention of the telephone, and he used this sum in founding, in Washington, D. C., an institution 'for the increase and diffusion of knowledge relating to the deaf,' which he christened the Volta Bureau. It occupies a handsome fire-proof structure, erected in 1894, at an outlay of $50,000, and as the contents of the building represent a similar outlay on Dr. Bell's part, the advantages that the deaf, and especially the instructors of the deaf, will gain from the researches

promoted by the Volta Bureau are incalculable. Since 1890 the work of the Institution has been in charge of Hon. John Hitz, formerly Consul-General from Switzerland, who superintends the impartial gathering, compiling and disseminating of serviceable information concerning deaf individuals and families in all countries, to the end that authentic information may be available that will afford to all nations a better knowledge of the causes that lead to deaf-mutism. Since its organization, the Volta Bureau has gratuitously distributed more than 20,000 books, pamphlets, circulars and charts, among teachers and specialists interested in the education and welfare of the deaf located in all parts of the world."

Street Car Operation in New York and in London.

Mr. J. Allen Baker, chairman of the Highways Committee of the London County Council, has drawn up a memorandum on the working of the street car system in New York, and this has, by direction of the committee, now been printed.

There are now 210 miles (counted as single track) of conduit lines in New York, compared with 185 miles of tramways in the county of London. As to the London tramways, 156 miles are owned by the council, while 29 miles still remain to be purchased, the last falling in 1911. Mr. Baker makes some interesting comparisons between the New York and London systems, the principal points being brought out in the following table:

	New York, 210 miles (single track).	London, 54 miles (single track).
Gross earnings per car mile..	1s. 4½d.	1s.
Operating cost per car mile, including repairs, renewals, etc.	7½d.	Estimate without renewals. 7s.
Cost per track mile for conduit cleaning per annum.	£100	Estimate for current year, £134
Cost of constructing conduit line per mile.	£20,000 to £25,000	£14,800
Cost of feeder cables per mile	£3,200	£1,500
Cost of power station and sub-station per mile of single track.	£5,800	£5,850
Speed at which cars run.	10 miles an hour	8 miles an hour
Hours of motormen.	10 hours' labor (in 12 consecutive hours)	10 hours' labor (in 12½ hours aver.)
Pay of motormen per day.	8s. 8d. to 10s. 4d.	4s. 9d. to 6s. 3d. (74 p. ct. at 6s. 3d.)
Pay of conductors per day.	8s. 3d. to 9s. 9d.	4s. 9d. to 6s. 3d. (65 p. ct. at 6s. 3d.)
Pay of conduit cleaners per day.	7s. 2d.	5s. 4d.
Pay of car cleaners per week	£2 3s.5d. to £2 10s.6d.	£1 5s. to £1 7s. 6d.

As to fares, a universal five-cent fare is charged in New York, but owing to a transfer system the average fare per journey works out at slightly more than 1½ d., and a single fare may be made available for a distance of 15 miles. In London the council's highest fare is 3d. for 6½ miles, and the lowest ½ d. for about a mile. Allowing for workmen's tickets, etc., the average fare on the council's tramways is about .93 d.

The constructional costs in New York are about .50 per cent. higher than in London owing to some excavations having to be made through solid rock, greater cost of labor, and more pipe obstruction.

Mr. Baker thinks the memorandum shows with what remarkable economy a complete conduit system can be operated in a large city like New York, and that it indicates that a "slight readjustment of the council's present fares, or the stages now given for a ½ d. or a 1 d. fare, would add materially to the earning power of the lines."

Electricity on the New Cunarder.

The latest Cunard steamer to be built and to arrive in New York harbor is the *Caronia*, which is 675 ft. long, and has a breadth of 72 ft. 6 in., with a depth of 97 ft. from bridge to keel. Her smoke-stacks attain a height of 150 ft. above the keel. She has quadruple-expansion engines of 20,000 indicated hp, equal to a speed of 20 miles an hour.

Down in the engine room of this mighty ship there is evidence of most minute attention to not only the perfection of the machinery, but thought for the comfort of the engineers and stokers, who man the 13 boilers and 54 furnaces which supply steam. An approved system of forced draught is adopted, as well as noiseless ash lifts and various other features. The illumination of the ship is, of course, accomplished by electricity, the work being so well performed that every corner of the great vessel is completely illuminated. To do this four large dynamos of 750 amp. at 100 volts are required, and the light is furnished to more than 3,000 individual lamps and a powerful searchlight.

Another important installation is the refrigerating machinery and cold storage. This is one of the largest plants ever placed on board ship. The 13,600 tons of dead weight cargo which the *Caronia* will carry is all handled easily and quickly by the 16 steam winches. There are, in addition, two electrically-driven winches on the boat deck for handling the life boats. The culinary department of the ship has been given most careful attention, the principal kitchen being of vast size and magnificent fittings, including electric roasters, steam ranges and stockpots, silver grilles and everything that ingenuity can contrive or experience suggest for the preparation of food under the best conditions. There are even automatic egg boilers, sandwich-making machines and such modern contrivances unknown on other ships.

Elgin, Ill., to Abandon Municipal Operation.

After municipal operation of the electric light plant since 1888, the city council of Elgin, Ill., has decided that such operation is a failure and has voted to contract for a period of ten years with the Elgin, Aurora & Southern Traction Company to furnish street arc lamps at $58 per year. The ordinance passed the council by a vote of 10 to 3 and now awaits the signature of Mayor Hubbard, who is absent from the city.

Alderman Benjamin S. Pearsall, chairman of the finance committee, who is responsible for the ordinance, and who was seen by a representative of this paper, presents some very interesting figures concerning the cost of lighting since the establishment of the plant in 1888. He wisely is not content to consider the running expenses from year to year alone as determining the cost, but in addition he considers the expenses of maintenance and betterment throughout the period of operation by the city. His figures for the period are as follows:

		Arc lamps.
Purchase price of plant	$25,546.12	
Total expenses 1888	10,232.79	..
Total expenses 1889	26,049.81	73
Total expenses 1890	5,780.79	75
Total expenses 1891	6,104.63	77
Total expenses 1892	5,887.24	77
Total expenses 1893	15,154.65	101
Total expenses 1894	7,657.30	106
Total expenses 1895	12,754.98	123
Total expenses 1896	12,472.04	155
Total expenses 1897	13,184.17	181
Total expenses 1898	17,098.78	183
Total expenses 1899	15,303.81	200
Total expenses 1900	19,728.01	209
Total expenses 1901	26,361.74	220
Total expenses 1902	26,217.84	220
Total expenses 1903	32,318.92	229
Total expenses 1904	28,209.24	247
Total expenditures	$306,052.84	2476

During this time, he says, there has been received for incandescent commercial lighting $16,356.12. The incandescent service to the city he estimates at a value of $12,000, giving a total income for the plant of $28,356.12. This he subtracts from the total expenditures, leaving a net expenditure of $277,696.72. From this figure is subtracted the highest estimate of the present worth of the plant, $100,000, and the remainder, $177,696.72, is the price paid for 2,476 arc lamp years during the past sixteen years. This shows an actual expenditure of $71 per lamp per year. The lowest estimated value of the plant raises the cost per lamp to $96 per year.

The contract with the Elgin, Aurora & Southern Traction Company stipulates that the company may use the engines and dynamos of the city plant. The present installation of 247 arc lamps are to be operated at $58 per lamp per annum, additional lamps up to 350 at $48, and in excess of this at $42. Current for incandescent lamps is to be supplied to the city at 4.66 cents per kw-hour. To business houses the rate is to be 20 cents, to dwellings 15 cents, a sliding discount scale to 40 per cent. being provided for both classes of service.

City electrician W. S. Skinner, together with others, does not approve of the action of the council. With a sufficient appropriation to install enclosed arc lamps he says the expense of the lamps will be reduced to $44 per year. Further, the receipts from commercial lighting are increasing with such rapidity that they will soon decrease the actual cost of the arc lights considerably below this figure. While the new contract stipulates $58 per lamp, the fact that the city will still be required to maintain a city electrician at $900 per year

raises the actual cost to almost $62. The contract provides that the city shall pay for all extensions of line and for installation of new lamps, and these expenses he says will increase the cost per lamp materially.

The action of the City Council has aroused considerable opposition among some of the citizens. The feeling culminated in a mass meeting, at which resolutions were drawn protesting against the action of the council. The opposition party, which felt confident that Mayor Hubbard, now absent in Florida, would veto the ordinance, were nonplused when the mayor sent the following signed communication to the citizens: "The finance committee and council as a whole have given this question much time and study, and I feel bound to concur in the conclusions which the council reached in this matter, and therefore have approved the ordinance and returned it to the city clerk with directions to attest and file the same.

CURRENT NEWS AND NOTES.

WIRES IN DETROIT.—The City of Detroit has under consideration a plan for putting its wires underground. The estimate of cost for the electric lighting commission's circuits is $280,000; the fire commission, $40,000, and the police commission, $40,000. An ordinance now up requires that all wires and cables "within the mile circle" shall go underground.

MUNICIPAL LIGHTING STATISTICS.—The data asked for by the National Electric Light Association to be used for the annual revision of its pamphlet containing municipal lighting statistics are being returned this year with unusual promptness. This is one of the most useful publications of the association, and every year shows a growing disposition on the part of electric light companies to do their share toward keeping it accurate and up to date.

PARISIAN PROMPTNESS.—A cable dispatch from Paris a few days ago says: "An amusing instance of the respect of the French for formalities is the fact that the Metropolitan underground railroad, which has been running for about four years without having been officially opened, is at last to have an official inauguration. The feud between the municipal and State authorities prevented this formality in 1900. The ceremony will take place shortly, the procession starting from the Place de l'Opera."

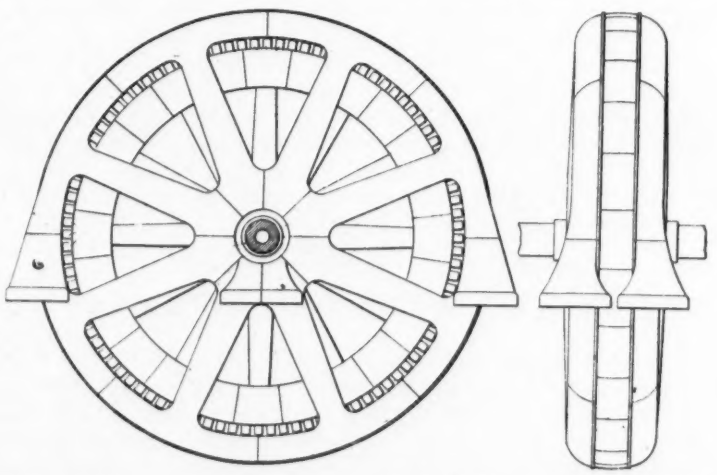
A PLEA FOR MUNICIPAL OWNERSHIP.—One thousand plumbing contractors in Manhattan and scores of manufacturers and dealers in plumbers' supplies are protesting against a condition of affairs which, they say, is costing them hundreds of thousands of dollars and producing a corresponding benefit to several corporations and individuals closely identified with the present administration under city ownership of the water system and the operation of the building department. These men declare that recent rulings made by Isaac A. Hopper, Superintendent of the Building Department of Manhattan, practically place the control of the plumbing business in the hands of four concerns, and that repeated appeals to Charles F. Murphy, Mayor McClellan, Corporation Counsel Delany and Mr. Hopper have availed them nothing. They offer documentary evidence of their statements. But do they not know that municipal ownership involves all that kind of thing, anyhow?

NEW YORK LIGHTING BILLS JUSTIFIED.—The recent legal—or illegal—attempts to prevent New York City from payment of its old lighting bills have been frustrated. Controller Grout is now authorized to pay to the gas and electric light companies the bills amounting to $1,200,000, which he had agreed to pay in case they would release the city from all charges for interest. The bills covered the period from January 1, 1903, to November 1, 1904, when no agreement as to the price to be charged for lighting could be reached. When the Controller proposed to pay the bills and Commissioner Oakley proposed to make a new contract for lighting on the old terms, Mr. W. R. Hearst brought a taxpayer's suit and secured a temporary injunction putting a stop to the whole proceedings. The Appellate Division of the Supreme Court for the Second Judicial District last week dissolved the injunction and permitted the city authorities to settle the claims of the lighting companies, as if Mr. Hearst had never interfered. Judge Miller writes the decision, which is to the effect that there is "no proof of fraud, collusion, corruption or bad faith," as charged in the action.

MARCONI'S NEW INVENTION.—A cable dispatch from London of March 3 says: "Mr. William Marconi, in a lecture before the Royal Institution, announced an invention of great importance to the efficiency of his system, which has hitherto been hampered by inability to receive more than twenty-four words a minute, and this only by means of a telephone attached to the receiver. By the method no documentary record of messages was made. Mr. Marconi said: "I have been able very recently to construct a magnetic detector which will work a relay, enabling messages to be recorded on a tape by the ordinary Wheatstone recorder. The new receiver is far simpler than any yet devised for wireless telegraphy. It requires less attention, and is absolutely reliable. The principal advantage is, however, that the receiving speed is increased from twenty-four to 100 words a minute." Mr. Marconi hinted at further improvements in receiving that he is elaborating in conjunction with Prof. Fleming.

UNIVERSITY OF MINNESOTA LECTURES.—Mr. Fred G. Dustin, city electrical inspector of Minneapolis, gave an interesting lecture on February 24 before the Society of Engineers of the University of Minnesota. After describing the development of the present insurance rules through the co-operation of the electrical and insurance organizations, he took up the city ordinance governing electrical installation and operation. To illustrate the necessity for certain rules, he showed interesting samples of defective fittings and construction which had been condemned. Samples of new devices showed how the rules are being met by improved construction. Among other instances of improper operation, he told of one place where the only fuse in the circuit had been replaced by a ten-penny nail. In closing, he admonished the young engineers to supplement their theoretical work with practical experience, emphasizing the truth that their ultimate success or failure would depend upon their ability to put into practical use the technical training and knowledge they were acquiring. On March 10 Mr. W. E. Ely, of the Murphy Iron Works, Detroit, will lecture on "Smoke Prevention." On March 17 Mr. C. E. Downton, of the Westinghouse Electric & Manufacturing Company, will give an illustrated lecture descriptive of the Pittsburg works of the company. On March 24 Mr. Benj. Waller, resident engineer of the Northwestern Telephone Exchange Company, will discuss the engineering features of a modern telephone plant.

SECTIONAL FRAME FOR ALTERNATORS.—In the design of very large generating units it is necessary to consider the difficulties to be encountered in shipping the parts and in erecting and assembling the machine. In construction, which forms the subject of a patent issued to Mr. B. A. Behrend, February 28, the stationary frame is made up of two shields or end-frames provided with pedestals, which shields act as a support for the main frame, which is clamped between them, as seen in the accompanying illustration.



The shields and main frame are subdivided into segments varying in number with the size of the machine. Since the shields support the main frame, the latter need not be designed as a supporting yoke, but only for such strength as to take the weight of the laminations and windings carried thereby. For this reason the outer diameter of the machine is greatly reduced compared with what would be necessary if the main frame of the machine also served as a supporting yoke.

MIDWAY ISLANDS.—The Commercial Cable Company, or Mackay interests, have asked Congress to improve the Midway Islands in the Pacific, where there is a cable station, by erecting a light house and deepening the approaches to the island. In all $250,000 is asked.

CONVENTION OF MUNICIPAL ELECTRICIANS.—The tenth annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 29, 30 and 31, 1905. Subjects for papers have been selected and assigned as follows: "Local Distributing Centers for Fire Telegraph Systems," "Underground Construction," "Best Methods of Overcoming Induction on Police Telegraph Circuits," "Advisability of Fusing Fire and Police Telegraph Boxes," "The Necessity of a Rigid Inspection by the Municipality," "Electric Light Engineering," "Electric Light Plants." Mr. Frank P. Foster, Corning, N. Y., is secretary of the association.

STARTER FOR MERCURY VAPOR LAMPS.—For the purpose of breaking down the initial high resistance at the negative electrode in mercury vapor apparatus, Mr. Percy H. Thomas proposes in two patents issued February 28 to employ a high e.m.f. obtained from the secondary of a transformer and to arrange the phase of this e.m.f. so that the apparatus may be started at the proper point of the e.m.f. wave without requiring any increase of e.m.f. at the main supply leads. To obtain this result the secondary of the transformer is connected between one of the terminals of the lamp and an auxiliary starting band, while in series with the primary may be placed a resistance or inductance for properly timing the secondary e.m.f. with respect to the e.m.f. of the mains.

ANOTHER ELEVATED ROAD.—There is a probability that an elevated railroad will be built through Baxter Street and private property to connect the Brooklyn, Williamsburg, and Manhattan Bridges to Brooklyn if the Rapid Transit Commissioners put through the plan upon which they have decided. It will cost the city about $5,000,000, and most of the sum will be a dead loss if the Commissioners stand by their belief that the structure should be merely a temporary one, to be destroyed as soon as possible after five years. Although the plan favored by the Commissioners does not appeal to them as an ideal one, the general sentiment was that it would offer the quickest relief to the present crowded transit conditions between Manhattan and Brooklyn.

LOW-FREQUENCY GENERATOR.—As ordinarily constructed the generators of current at a very low frequency are abnormally large, due to the very low speed at which they must run. Thus, if one wishes to produce currents of a frequency of five periods per second by the ordinary method, the speed cannot ordinarily be greater than 300 r.p.m. In order to be able to construct a low-frequency machine of normal size, Mr. William Stanley, according to two patents issued February 28, 1905, would use an armature similar to that of a direct-current machine, which he would drive at any desired speed in a magnetic field excited by alternating current at the required low frequency obtained from a small-sized special low-frequency exciting generator. The e.m.f. at the brushes will alternate at the desired frequency, while the high speed at which the generator can be run enables it to be made of comparatively small size.

TELEGRAPH LINES IN SOUTHERN NIGERIA.—Under date of January 2, 1905, United States Consul Liefeld, Frieburg, Germany, transmits the following extract from the Paris edition of the New York *Herald* of December 31, 1904: An important extension of telegraphs is about to be made in southern Nigeria, says Reuter. The work, which will be commenced at an early date, will occupy about a year, and involves the laying of 400 miles of wire. Starting from a point on the Calabar-Bonny system, the line will strike inland to Onisha, on the Niger, and will continue west across that river to Benin. From that point it will turn south to Wari, and be taken across to Lagos. At present there are no lines in the interior of southern Nigeria, but when the work now about to be taken in hand is complete a great portion of the known part of the British protectorate will be tapped. At Lagos the new line will join the interior telegraph, which at present extends to Kano and is being pushed on to Sokoto.

ELECTRIC POWER FOR LONDON POST OFFICE.—In forwarding telegrams in bulk, pneumatic tubes have proved to be of immense public advantage in London, and 42 miles of tubes now radiate from the General Post Office to the principal post offices within a distance of two or two and one-half miles. The principle would, no doubt, have been more widely adopted had the necessary power been available. It is now proposed to establish in the metropolis a central power station, the electric current from which will be transmitted by suitable cables to the General Post Office, and the boilers and machinery now installed at St. Martin's-le-Grand will be replaced by electric motors for the working of the pneumatic tubes, while the electric current will be used for lighting, charging telegraph batteries and many other services in connection with the Post Office. The three-phase system will be used, the initial capacity being about 2,000 kw. It is expected that the new generating station will be ready for use during the summer of 1906.

THE SUPPLY OF COAL IN BRITAIN.—In answer to the persistent and dire prophecies of exhausted coal fields and the consequent collapse of British manufacturing industries and the loss of the command of the seas, the coal commission stated recently that there seems no present necessity to restrict artificially the export of coal in order to conserve it for the home supply. As the result of elaborate inquiries it is estimated that the available supply is 146,874 million tons, while the annual output is 230 million tons. The commissioners, however, direct attention to the extravagance in steam consumption, the average coal consumption per hp-hour being about 51 pounds, although it should not exceed 21 pounds. There is a great waste at present owing to engines being scattered over factories, with long ranges of pipes and small, inefficient boilers. The use of oil and gas engines, they find, is increasing, but they consider that for greater economy the proper solution involves the general installation of central power stations. With electrical power stations and electric motor drives, power should be delivered at the work for less than 21 pounds of steam at the prime-mover.

ADJUSTABLE VAPOR DISCHARGE DEVICE.—An invention patented February 28 by Mr. Percy H. Thomas has for its object to provide means whereby a mercury vapor discharge device may be constructed so as to operate under different adjustable pressures. The starting band is built in sections placed at distances more or less remote from the surface of the mercury, one band being below the mercury surface. By means of a switch any desired starting band may be used, requiring a corresponding critical strain at the negative electrode. A second patent granted to the same inventor contemplates the utilization of that property of mercury vapor which allows current to flow in only one direction after the resistance at the negative electrode has been broken down, in order to insure the delivery of the proper electrical energy to a receiving circuit by using under different conditions of demand different portions of the cycle from the source of supply. The time of the breaking down of the resistance being selected so as to correspond with a certain portion of a cycle, the energy made use of in the receiving circuit may be of any desired amount within the capacity of the supply circuit.

STEAM RAILROAD LIGHTING PLANTS.—Mr. Ralph G. Griswold, assistant electrical engineer of the Pittsburg & Lake Erie Railroad, Pittsburg, Pa., sends us the following data: "The Pittsburg & Lake Erie Railroad has three electric plants one at Pittsburg, which lights the terminal station and offices and runs the elevators; one at McKees Rocks, four miles west of Pittsburg, which lights and furnishes power to repair shops at that place, and a small plant at Youngstown, Ohio, which furnishes light to the terminal yards and power to the turntable motor. At Pittsburg there are Babcock & Wilcox boilers, equipped with Roney stokers, furnishing steam to compound Westinghouse engines, direct conected to Westinghouse direct-current, 110-volt, 120-kw. generators. At McKees Rocks there are Babcock & Wilcox boilers and Roney stokers, furnishing steam to Westinghouse compound engines, direct connected to Westinghouse 150-kw., 240-volt, direct-connected generators. The extensive and up-to-date repair shops are equipped throughout with multiple-voltage variable speed motors on the individual drive in almost every case. Two hundred and forty-volt lamps are used throughout, and the arc lamps are run on a three-wire system with a balance.

LEGAL RATE FOR CURRENT.—A bill has been introduced into the New York Legislature which proposes to establish a rate of 7 cents per kilowatt for electricity.

TELEPHONY IN CHICAGO.—The increase in the number of telephones installed by the Chicago Telephone Company during February was 1,664. The company now has 121,238 instruments in service.

FRENCH TELEPHONE GIRLS.—The decision of the Supreme Court of France refusing to recognize telephone girls as State officials is a great blow to feminine pride. The Paris service is bad enough at present, but worse is expected to follow this deprivation of an official status and the assimilating of the girls to ordinary commercial employees. The public, nevertheless, is jubilant, as no prosecution for insulting State servants is now possible. In the future, so far as the telephone service is concerned, it is believed that the high standard of efficiency of America will now be obtainable. The service in New York that the *Herald* belabors so unjustly is the French ideal for adoption.

FOR TELEPHONE MERGER.—At the New Jersey Legislature, Senator Wakelee has introduced a bill in the Senate to incorporate telegraph companies approved April 9, 1875. It permits such companies to increase or decrease capital stock, change the par value of shares, change the name, extend the corporate existence, create one or more classes of preferred stock, and make other change or amendment in its certificate of corporation not repugnant to section 27 of the general corporation act of 1896. The certificate of the secretary of state is to be sufficient proof of such action having been taken. The bill is intended, it is alleged, to facilitate the big national telephone merger and there is a companion bill.

CLASSES AND MASSES.—A cable dispatch from London of February 25 says: Charles T. Yerkes, formerly of Chicago, and now the London traction magnate, has been compelled to succumb to the strength of the prevalent English belief in "class distinctions." Mr. Yerkes desired after the electrification of the underground railway to abolish "classes" and make all passengers travel as one class. Some Londoners, however, decline to be unclassed, so there is to be a special car on each train, in which the fastidious Londoner can hide himself upon payment of an extra fare. As a sort of parting kick, Mr. Yerkes's manager, Mr. Perks, has bluntly announced that the extra cars are for passengers who desire to travel "without coming into contact with workingmen."

MILLION DOLLAR PATRIOTISM.—A traction railroad deal representing about $1,000,000 has just been completed in Cleveland, whereby a local syndicate acquires the property of the Lorain Street Railway Company, which connects the cities of Lorain, South Lorain and Elyria. Besides owning a right of way between Lorain and Elyria, the company has a blanket franchise on all the streets of Lorain for a period of twenty-five years. The members of the syndicate are identical with the interests controlling the Lake Shore Electric. The Lorain-Elyria line will ultimately be merged with the Lake Shore Electric. The Lorain Street Railway Company is the property of Mayor Tom L. Johnson, Cleveland, and the Dupont family. It has a capital stock of $750,000. Mr. Tom Johnson, while attacking every trolley system but his own, has made piles of money out of trolley enterprises. This is one of the piles.

TRAFFIC IN BERLIN.—Mr. Frank H. Mason, U. S. Consul-General at Berlin, in a report to the State Department, says: "There were carried during the fiscal year 1903-4, in Berlin, by the elevated steam railway (Stadtbahn), 36,083,553 passengers; by the circular electric railway (Ringbahn) 23,240,173, and by all the other electric surface and underground lines, 397,578,962, a grand total of 456,902,488 passengers. To these are to be added 85,878,795 passengers carried by the several omnibus lines, which, notwithstanding the steady extension and improvement of the electrical tramway system, continue to handle an increasing traffic from year to year. The whole number of accidents during the year was 2,146, of which 31 were fatal, which in respect to cause and responsibility were described as follows: Elevated and underground lines, 26 injured, none fatally; surface electric tramways, 1,985 injured, 26 killed; omnibuses, 134 wounded, 5 killed, a rather disastrous record, but perhaps not more so than would be expected when the vast total number of passengers carried and the crowded condition of many narrow Berlin streets are considered."

AMERICAN ELECTROCHEMICAL SOCIETY.—Among the papers that will be read at the annual meeting of the American Electrochemical Society, to be held at Boston and Cambridge, Mass., April 25, 26 and 27, are the following: A. Reuterdahl, "The Interdependence of Atomic Weights and Electrochemical Equivalents"; C. Hambuechen, "An Optical Method of Observing a Diffusion in an Electrolyte"; A. B. Albro, "The Microstructure of Silicon and Silicon Alloys"; Dr. L. Kahlenberg, "Osmosis"; Prof. H. R. Carveth, "Electrolytic Precipitation of Chromium"; Dr. J. W. Richards, "Conduction in Electrolytes"; Prof. J. C. Blake, "The Migration and Coagulation of Colloidal Suspensions"; C. G. Richardson, "Water Powers of the Canadian 'Hinterland'"; R. C. Snowden, "Electrodeposition of Silver"; R. C. Snowden, "Adherence of Nickel to Nickel"; Ernst Fahrig, "Treating Low-Grade Ore and Tailings by Electrolysis"; Carl Hering, "Removing Solvents During Electrolysis"; A. Lodyguine, "Some Experiments with the Reduction of Titaniferous Ores into Steel and Titanate of Iron—Experiments with the Reduction of Different Oxides of Lead by Electric Current—Some Results of Experiments with the Electrodisposition of Metals on Aluminum"; H. M. Goodwin, "On Billitzer's Method of Determining Absolute Potentials"; G. A. Hulett, "A Low-Voltage Standard Cell."

UNINTENTIONAL THIRD RAILS.—The New York *Tribune* of February 26 notes the following incident: "The Central Railroad of New Jersey was tied up at Somerville for three hours last night as the result of a trolley wire charging the rail with electricity and disarranging the block system for eight miles. The trolley line of the Public Service Corporation passes under the railroad by a subway. An overhead wire in the subway, in some manner that is still a mystery, was placed in contact with the iron trusses of the Central's overhead bridge about midnight. The bridge became so heavily charged with electricity that one of the iron trusses was melted and and the rails of the main track became red-hot. An electric current spread through the rails for a distance of five miles on either side of the bridge that endangered the lives of passengers and railroad operatives. The heavens were brilliantly illuminated for miles around by great flashes of blue fire, as the strong current of electricity played tag along the rails in the open country. A still alarm was sent in to the local fire department, and the firemen responded with a chemical engine and finally shut off the electric current by passing a wire over the trolley wire a short distance from the bridge and pulled it to the ground. The rails and trusses of the bridge were so badly warped by the heat that it was necessary to replace them to resume traffic."

TELEGRAPHIC RED TAPE.—In the recent souvenir issue of the English *Electrical Magazine*, Mr. F. W. Jones, chief electrician of the Postal Telegraph-Cable Company, speaks thus forcibly: "I cannot rid myself of the feeling that much more could have been contributed to the Electrical Congress, particularly in relation to telegraphs and telephones, by electrical engineers in England, and upon the continent of Europe, if they had been less hampered by the governmental 'red tape' to which those systems of electric communication are subjected. To illustrate this, I took the liberty a few years ago of writing directly to Dr. Stephan, in Berlin, for some very general and ordinary information about the operation of underground cables in Germany, and was surprised at his very courteous reply to be informed that it would be necessary for me to apply to the German Government, through the Secretary of the United States at Washington, in order to secure the desired information, as his government could not recognize the request coming directly from an official of a private corporation. This incident has inspired me with a fear, as above intimated, that some such a technicality has prevented various sections of the Congress from being more fully enriched by the valuable information which many government telegraph and telephone officials possess. There were some very happy exceptions, however. One was in the valuable information conveyed by Mr. John Hesketh, of Queensland, Australia, who represented the Commonwealth of Australia."

The Edison Electric Company's System in Southern California—III.

TUNNEL EXCAVATION.

PRACTICALLY all of the tunnels are being driven through solid rock, so that they have been connected with the compressor houses by pipes, and the work is being carried on with pneumatic drills. The pipe consists of 3-in. steel casing for the smaller plants and 4-in. for the larger ones. In all, there are about 12 miles of this pipe, the longest single stretch being 12,000 ft. to one of the tunnels from Camp No. 2. The pipe is all laid in the open, and the work of laying it was quite difficult. At points of heavy strain, expansion joints are used, since the differences of temperature between midday and night are apt to be excessive during the summer months. An air pressure of from 80 to 90 lbs. per sq. in. is carried on all the systems.

At each adit, or tunnel opening, the compressor pipe is connected to a receiver, from which the pipes are carried along the floor of the tunnel to the face. Fig. 22 shows the receiver in the adit of lower No. 14 and upper No. 15, and gives a good idea of the nature of the rock encountered on the work, which, in most cases, is a gray, close-grained granite, and very hard to work. In a few spots sand and disintegrated granite have been met. Practically no trouble has been experienced from water seepage.

The air drills used are of the giant type, manufactured by the Chicago Pneumatic Tool Company, the Rix Compressed Air Machinery Company and the Compressed Air Machinery Company. Two drills are worked at each face. For each blast are usually drilled about 16 holes, consisting of 4 "uppers," 4 back holes, 4 "cut-ins," and 4 lifters. A blast requires about 50 lbs. of dynamite, Hercules Nos. 1 and 2, 40 and 60 per cent. being used. As a rule, the blasts are set off at night or at evening between shifts. The broken rock from the blast is loaded into 2-ton steel ore cars and hauled by mules on the track to a dump at the mouth of the tunnel. A cubic yard of the rock weighs over a ton.

Usually the dumps are below the grade of the main trail so as to cause no interference with the pack trains or persons on the trail. Flat cars are used to handle the large and heavy rocks, and also for the removal of the drills during blasts. After the tunnels are excavated about 400 ft. from the mouth, it becomes necessary to install ventilating systems. A blower of the Root reversible type is installed near the opening of the tunnel or adit (see Fig. 22), and this is connected with the working face of the tunnel by means of 7-in. or 8-in. galvanized iron stove pipe, suspended from a cable or single wire. The joints are rendered air tight by covering them with cheesecloth and a coating of asphaltum. From 50 to

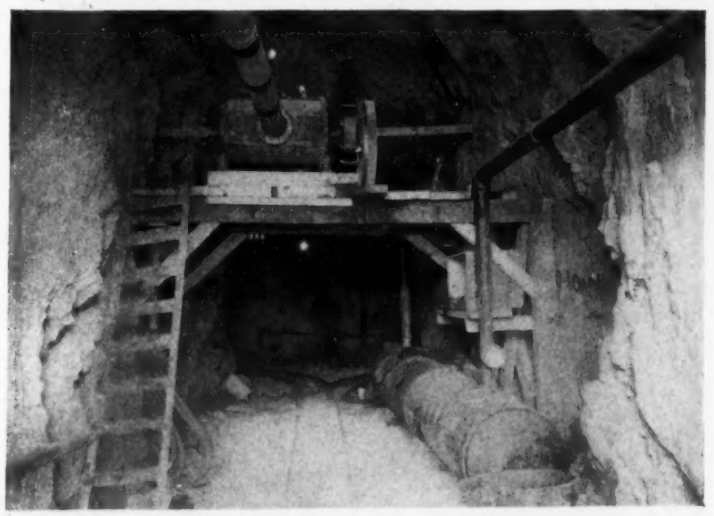


FIG. 22.—ADIT OPENING, KERN RIVER PLANT.,

100 feet are added to each pipe every month, the pipe being installed in 30-ft. lengths. The ventilating systems are reversible, fresh air being forced into the tunnel when the men are working, and the direction of the air being reversed when a blast is shot off so as to clear the tunnel of smoke and dust.

The tunnels are all lighted by means of electricity, and wherever possible the wires and lamps have been hung permanently on iron brackets from the roof, so that they can be used in patroling the tunnels in skiffs after the water is turned in.

Compressed air is available at nearly all the tunnel entrances for operating blacksmith forges that are used to temper the drills and to make small repairs.

The present rate of progress on all the tunnels is between 3,000 and 3500 ft. a month, and the average advance at each face, where air drills are used, is about 7 ft. in 24 hours. The company is doing all its work with day labor in two shifts working nine hours each. The only contract work on the job has been for the supply of provisions and the feeding of the men. Very careful account is being kept of all items of expense, so that the exact cost of the different features of the work can be determined. The account of these costs will be of great value to the company in determining whether it will pay or not to continue to do its own work on the other plants above No. 1, or whether it would be more profitable to contract for the work. Work on No. 1 plant was started in November, 1902, and after the construction plant was completed in August,

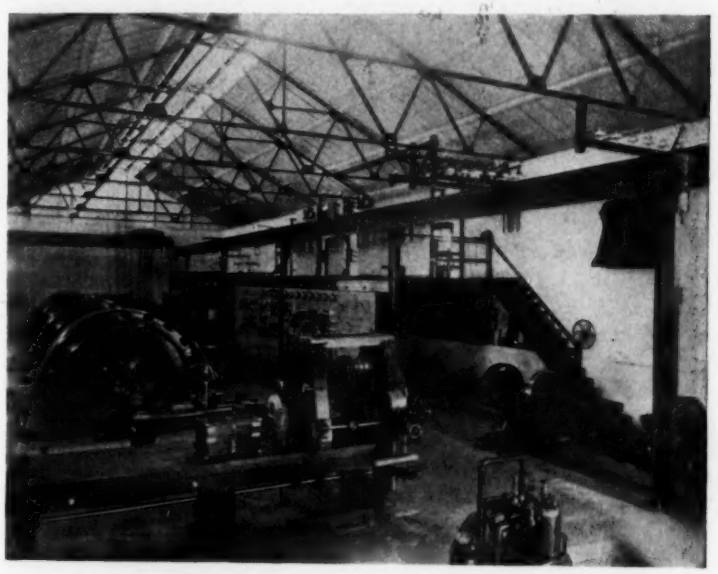


FIG. 23.—INTERIOR SANTA ANA RIVER PLANT NO. 1, SHOWING IN FOREGROUND PIERSON'S "MACHINE SHOP."

1903, about 500 men were employed until last January, when the force was cut down to about 75 men. The company is now actively engaged in completing its Santa Ana No. 2, and Lytle Creek plants, and also a large steam turbine station in Los Angeles. When these are finished the force of men on the Kern River plant will be largely increased and the work pushed to completion.

KERN RIVER POWER PLANTS NOS. 2, 3, 4, 5 AND 6.

Of the five power plants located above No. 1 on the Kern River, Nos. 2, 3, 4 and 5 have been surveyed, and their general features determined upon. No. 2 power house will be located on the river just above the intake of No. 1, and will receive its water with a net head of 317 ft. through 11.5 miles of gravity conduit constructed similarly to that now being built for No. 1 plant. The point of intake for No. 2 will be a short distance above the junction of Kern River and Clear Creek. With a minimum flow of 200 second feet 5,800 hp. can be developed, and with the full capacity of the proposed conduit 11,600 hp. can be developed.

Above Edison Plant No. 2 is located the power house of the Kern River Company, already referred to, and above its intake on the North Branch of the Kern River is the site for the proposed Edison No. 3 station. This plant will have a net head of 760 ft., and with a minimum of 240 second-feet of water can develop 16,800 hp., the maximum being 28,000 hp. with 400 second-feet. Plants Nos. 4, 5 and 6 follow in succession up the North Branch of the Kern River, and may be described by the following data: No. 4, 910 ft. net head, 240 second-feet minimum flow, developing 20,000 hp., 400 second-feet full capacity, developing 33,370 hp.; No. 5, 1,158 ft. net head, 160 second-feet minimum flow, developing 17,000 hp., 300 second-feet full capacity, developing 31,800 hp.; No. 6, 880 ft. head, 150 second-feet minimum flow, developing 12,096 hp., 300 second-feet full capacity, developing 24,192 hp.

The following table gives data relating to the gravity conduits of the proposed plants, Nos. 2, 3, 4 and 5:

No. of plant.	Tot. length of lines in miles.	Tot. length of tunnel in miles.	Length of flume in miles.	Length of Force main in miles.
2	11.5	9	2.3	0.2
3	13.67	11.19	2.01	0.47
4	16.6	14.35	0.75	0.5
5	20.78	17.77	0.76	2.25

Power Plant No. 6 has not yet been surveyed, and the length of line and character of the work cannot as yet be given.

DATA RELATING TO HYDRAULIC POWER PLANTS OF THE EDISON ELECTRIC COMPANY.

Now that mention has been made of the general features of all the hydraulic power plants of the Edison Electric Company, the following tabular data of those in operation and nearing completion will be of interest.

FIG. 24.—INTERIOR OF MILL CREEK NO. 3 STATION.

Following are the data of the hydro-electric power plants now in operation:

Name of station.	Effective head in feet.	Machinery installed in horse-power.
Santa Ana River No. 1	728	4,000
Mill Creek No. 1	530	1,000
Mill Creek No. 2	627	400
Mill Creek No. 3	1,960	4,000
Total		9,400

Two other plants to be driven by water power are now nearing completion, as follows:

Name of station.	Effective head in feet.	Machinery installed in horse-power.
Lytle Creek Plant	485	1,000
Santa Ana River No. 2	310	1,000
Total		2,000

Another hydraulic plant will be ready for use for 1906, as follows:

Name of station.	Effective head in feet.	Machinery installed in horse-power.
Kern River No. 1	872	24,000

ELECTRICAL GENERATION AND TRANSMISSION SYSTEM.

The main artery of supply of current for the Edison Electric Company's system consists of the original 33,000-volt transmission line of the Southern California Power Company, extending from Santa Ana Canyon to the City of Los Angeles, a distance of 83 miles. This line is at present supplied from several points by both steam and water power plants, and current is distributed to a large number of sub-stations, some of them being steam plants, taking or giving power as the supply and demand may require.

SANTA ANA RIVER NO. 1 AND NO. 2 PLANTS.

At the upper end of the line is the original power station, known as Santa Ana No. 1. This plant is equipped with four 750-kw., 750-volt, three-phase General Electric generators, each mounted on a three-bearing frame with a Pelton water-wheel, the latter being on the same shaft as the rotating field, and supplied with a single nozzle of the deflecting type, under a static head of 728 ft. and an effective working head of 700 ft. The plant is arranged for two pipe lines. All the machines can be supplied from one line, or the plant can be divided into two separate hydraulic plants for convenience in making repairs to either portion. A general view of the interior of this station is shown in Fig. 23.

The transformer equipment includes four banks each of three 250-kw., 750-volt, to 33,000-volt, Y-connected air blast transformers, arranged to be connected to either of the two bus-bars of the low-potential board and to either of the two bus-bars of the high-potential board. There is also a double bus-bar for the exciters, of which there are three units of 300-kw each, direct-connected to Pelton impulse water-wheels. Both high and low-potential boards are equipped with knife switches of suitable size and capacity, the switches upon the high-tension board being separated by heavy marble barriers. It is never necessary to operate the high-potential switches under any conditions more severe than the breaking of the magnetizing current of the transformers. This condition is rendered possible by arranging the high-potential board with a panel for dividing each of the two bus-bars into two halves, each half having its group of transformers and lines, all line switching being done on the low-potential side of the transformers.

An interesting feature of the Santa Ana No. 1 plant is a "vest pocket edition" of a machine shop, shown in Fig. 23. This was designed by B. F. Pierson, chief operator of the company, when he was foreman at this power house. It consists of a motor belted to a shaft and two counter shafts, from which are driven a lathe, emery wheel, buffer, grindstone and drill press. The arrangement is all combined in a framework at the end of a work table, and can be easily moved about when necessary.

Santa Ana No. 2 plant is to comprise three 250-kw., 750-volt, three-phase generators directly driven by Abner Doble water-wheels and stepping up to 33,000 volts to feed into the high-tension transmission system.

MILL CREEK NO. 3 PLANT.

The other plant at this end of the valley, which is now connected directly into the 30,000-volt line, is the Mill Creek No. 3, finished in March, 1903. This plant is operating under a hydraulic head of 1960 ft., and has been in service for about two years without the slightest difficulty. The station is equipped almost identically with that of the Santa Ana No. 1 plant, except that for the three transformers of 250-kw. each, of the Santa Ana plant for a single three-phase group, there has been substituted one three-phase transformer of the air-blast type. An interior view of the plant is shown in Fig. 24, the picture having been taken last spring before the floor was completed. One of the four generators is driven by a Pelton water-wheel, and the other three by Doble wheels. Each wheel is equipped with a needle deflecting nozzle. The needle is hand regulated, the deflection being regulated by the governor. The needles have proved to be very satisfactory, and although they have been operated for over a year, the needles are still tight when closed, showing that when properly constructed they can be relied upon as a valve as well as a means of varying the size of the jet to meet conditions of water storage or of the varying of the amount of water in streams, which occurs in California during each 24 hours, on account of evaporation.

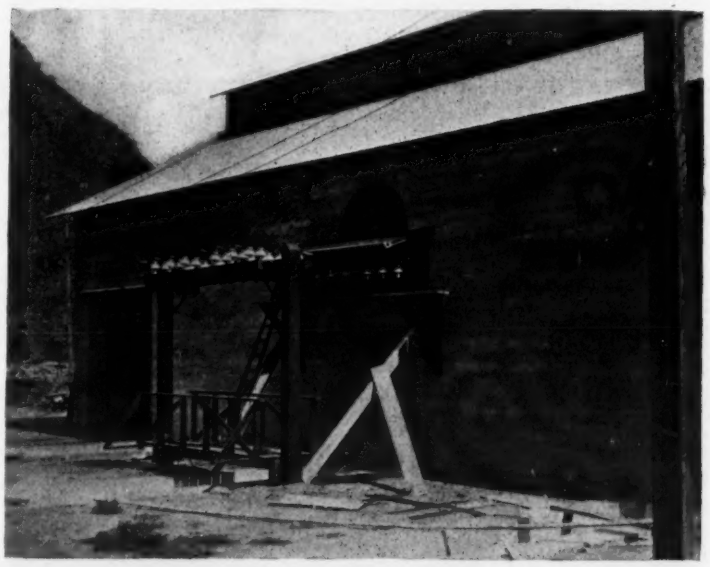


FIG. 25.—33,000-VOLT LINE COMING OUT OF NO. 3 MILL CREEK STATION.

The two 33,000-volt lines leave this station at the point shown in Fig. 25, and connect with the original 30,000-volt line at a point about four miles from the Mill Creek plant and 6½ miles from the Santa Ana No. 1 plant. Fig. 26 is a view of this point showing the junction pole of the two lines, and also the Mill Creek No. 3 switch pole and the telephone booth.

MILL CREEK NO. 2 PLANT.

In the same building with the No. 3 Mill Creek plant is located the Mill Creek No. 2 station. Originally two generators of 250-kw. capacity each were installed here. The turbines operated under a head of 630 ft. and the generators delivered the current at 11,000 volts to the transmission line, but owing to the fact that the Mill Creek No. 3 plant with a 4,000-hp. generator capacity has since been installed to generate current at 750 volts, which is transformed to 33,000 volts and delivered to the transmission line to Los Angeles, a change has been made in the generating equipment for the No. 2 station. This change consisted of removing the two 250-kw. generators and installing in their stead one 300-kw generator. This 300-kw. machine being of the same type as the Mill Creek No. 3 generators—750 volts—the station has been rendered uniform with 750 volts on the primary side and 33,000 volts on the secondary side of the transformers. The reason for cutting the capacity of Mill Creek from 500 to 300 kw. is that a portion of the water from the No. 2 force main is now being used to drive the exciters for No. 3 plant, and also because the new generator is so designed as to carry a considerable overload for a long period of time.

MILL CREEK NO. 1 PLANT.

Down the valley, two miles below No. 2 and No. 3 plants, is situated the original three-phase plant of the United States. It is known as No. 1 Mill Creek, and was installed by Dr. Louis Bell, the late A. W. Decker and O. H. Ensign, electrical and mechanical engineer for the Edison Company. This plant is equipped with the original T.-Y. machines (wound for 2,400 volts, three-phase, they being four in number), brought out by the General Electric Company. The station has a bank of four Wagner 100-kw. transformers and three General Electric air-blast, stepping up to 10,000 volts, the Wagners being oil-filled water-cooled. This plant operates under 530 ft. head, and has been in service since August, 1893.

REDLANDS SUBSTATION.

Coming down from the canyon to the town of Redlands, situated 14 miles from the Santa Ana Plant, and nine miles from Mill Creek No. 3, is the Redlands substation, which was originally built for the 10,000-volt system of the Redlands Electric Light & Power Company, and is now owned by the Edison Company. As originally laid out, all of the power of the Mill Creek plants Nos. 1 and 2, came into this plant at 10,000 volts, and from a bus-bar was transmitted out on several circuits, one to the Mentone Ice Company's plant, one to Highlands, one to the Colton and San Bernardino Districts, and another to the City of Riverside. These circuits are now well loaded up, and beside the 10,000-volt plants in Mill Creek supplying them, there is a bank of transformers of 800 kw. capacity connected to the 10,000-volt bus-bars from the 30,000-volt transmission line through an I.R.T. induction regulator, to correct the difference in voltage between the two systems.

This substation has a supplementary steam plant of about 700 kw. capacity, generating at 2,300 volts, which is the voltage of the distributing system of Redlands, connected to the general system through three 200-kw., 10,000 to 2,200-volt transformers.

There is also situated in this plant a motor-generator. The motor is wound for 10,000 volts, and the generator supplies railway current for the San Bernardino Valley Traction Company at 550 volts. This installation is interesting in that it is started from the switchboard from the alternating-current side by means of a compensator directly off the 10,000-volt bus-bars, and is an eminent success.

COLTON AND SAN BERNARDINO SUBSTATION.

Coming down the valley another ten miles one finds the new Colton sub-station which supplies the other end of the 10,000-volt distributing system above mentioned, feeding from the Redlands substation direct from the 30,000-volt line through three-phase, 600-kw., 30,000 to 10,000-volt transformers, equipped with regular heads. As the load at this point had climbed beyond the capacity desirable to distribute from the Redlands substation, it was found expedient to put in this substation to supply this vicinity.

Situated about five miles north from this substation, at San Bernardino, is the substation of the San Bernardino Valley Traction Company, having two motor-generator sets; the motors being connected off the 10,000-volt lines direct, the generators supplying 550 volts. Each has a capacity of 200 kw. There is also installed one 100-kw. rotary converter, supplied through suitable transformers. 100-kw rotary converter, supplied through a bank of three step-down transformers.

One mile west of the new Colton substation is the old substation of the town of Colton, having a capacity of 150 kw supplied from a circuit, which also carries the Colton Cement Works, a mile and a half further west, using about 500 kw. Both of these circuits are controlled from the above mentioned new substation. The Colton Cement Works installation may obtain power either directly from the 30,000-volt circuits or through this substation. The station is equipped with double 10,000-volt bus-bars provided with oil-break switches mounted on panels.

LYTLE CREEK PLANT.

About ten miles north of San Bernardino is the new Lytle Creek water-power plant, which will have a capacity of 1,000 hp. Pelton water-wheels are to be used. Two of the generators in this station are exactly similar in all respects to the 11,000-hp machines originally installed in Mill Creek No. 2. The output of this station is delivered to the 10,000-volt transmission lines of the Company supplying power for railway pumping and lighting purposes at Riverside, Colton and San Bernardino. The output of the Lytle Creek plant is also connected with the 33,000-volt transmission line to Los Angeles by means of transformers in the Colton substation.

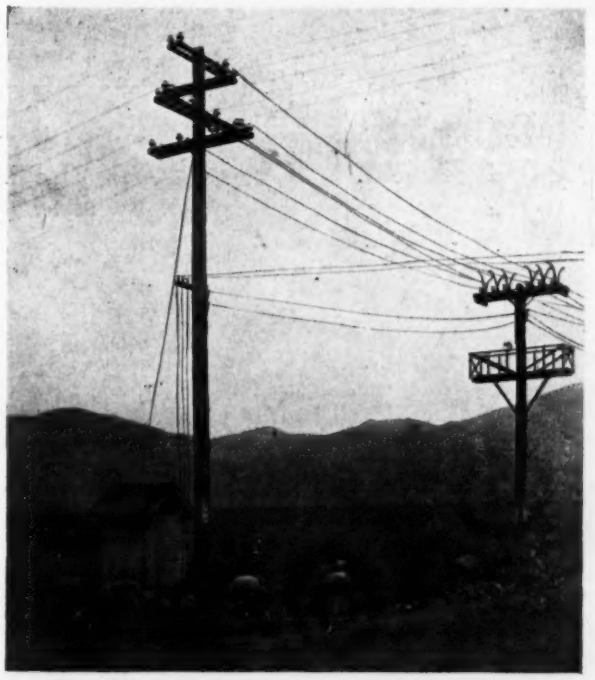


FIG. 26.—33,000-VOLT TRANSMISSION LINE.

POMONA, PUENTE AND PASADENA SUBSTATION.

Further west, 40 miles from the Santa Ana power house, is located the Pomona substation, in which are installed 900-kw. transformers in two banks stepping down to 2,300 and 10,000 volts, supplying power for pumping water over a considerable area and for a large local lighting business.

Fifteen miles further west is located the Puente sub-station, from which a 10,000-volt line branches 26 miles to the south, with small distributing substations at Whittier, Fullerton, Anaheim, Orange and Santa Ana distributing light and power at 2,200 volts. The line also supplies power at the full line voltage without transformation for the operation of irrigation pumps driven by induction motors at various points along its course.

About seventy-four miles from the Santa Ana station is the branch running 4½ miles to the Pasadena station, where is located 900 kw. of air-blast transformers, stepping down to 2,300 volts, for the local distribution. There is also at this plant a 250-kw. steam-driven generator, which is a relic of the old steam plant at this substation, and is used only for emergency purposes, such as when lines are being repaired during the daytime. The station is

equipped with plug switches for the 2,300 volts, and rams'-horn switches for the 30,000 volts.

LOS ANGELES NO. 1 STATION.

At the end of the line in Los Angeles, at Second and Boylston streets, is the original steam plant of the Edison Company, known as Los Angeles No. 1 station. This plant was built under strenuous efforts to keep up with the demands for business in the city of Los Angeles and was eventually made a part of the system being described, by placing in it 1,500 kw in air-blast transformers, wound for 30,000 volts and stepping down to 2,300. This station, by a 2,300-volt feeder, feeds the old Fourth Street substation, or Station No. 2, which is now being reorganized. It also supplies a very large and rapidly growing overhead system through 2,300-volt distributing lines. Some of these 2,300-volt circuits have a load as high as 500 kw. for house to house lighting, and are as much as five miles long, showing the need for the reorganization above mentioned.

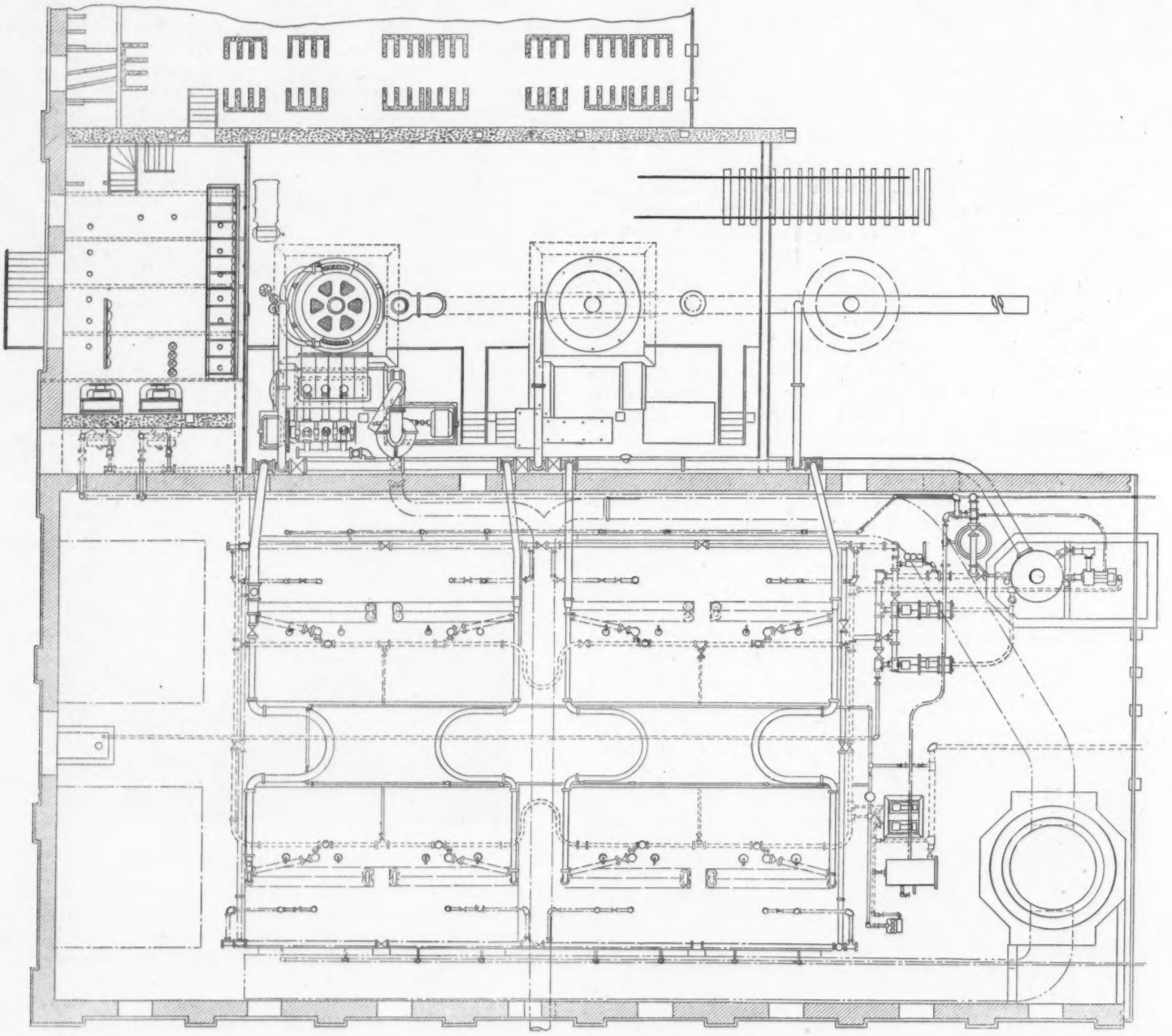


FIG. 27.—GENERAL ARRANGEMENT LOS ANGELES STATION NO. 3.

LOS ANGELES STATION NO. 3.

In the northern portion of the city on a part of the old bed of the Los Angeles River and adjacent to the Southern Pacific tracks is located the new steam plant for the Edison Company, known as Los Angeles Station No. 3. This plant is to be equipped as a large substation for the reception, transformation and distribution in the immediate vicinity of water-generated power, and for tying together the various water-power systems of the company centering at this point, and is also to include a supplementary steam plant. All these functions are to be combined in the one station using the highest type of modern apparatus. The steam plant with its transformer capacity is designed for 80,000 kw.

The building is complete as far as the present needs require, the design being such that extensions can easily be made to the south by the removal of the temporary bulkheads which now close that end. Fig. 27 shows the general arrangement of the steam part of the station, consisting of the boiler and steam-turbine rooms. The boiler room is 60 ft. wide, and is extended to a length of 125 ft., with a temporary bulkhead of sheet iron at the south end. The clear height of the room to the roof trusses is 28 ft. Three banks of boilers are installed, each bank consisting of two 500-hp. Babcock and Wilcox water-tube boilers, equipped with superheaters, superheating to 125 degs. above 150 lbs. pressure. There is room for another bank of boilers, the foundations for which are already in place. A feature of the piping is the large horizontal Y bends.

Water for the station is taken from a surface well 50 ft. deep, from which about 4 cub. ft. per second can be supplied. The plant is equipped with a concrete stack, 10 ft. inside diameter and 150 ft. high above the grate bars.

The turbine room is 39 ft. wide and 82 ft. in length to the temporary bulkhead at the south end. Of this length, 21 ft. at the

north end is taken up by a hanging gallery for the switchboards and exciters. From the ground floor to the roof trusses there is a clear height of 45 ft., and 39 ft. above the ground floor are located the tracks of a traveling crane, which reaches all parts of the room. The turbine floor and really the main floor of the room is 9 ft. above the ground.

There is at present installed one steam turbine of the Curtis type having a vertical shaft operating at a speed of 750 r.p.m. The unit has a rated capacity of 2,000 kw. and an overload guarantee of 3,000 kw. for four hours. A view of this unit with a glimpse of the switchboard gallery behind is given in Fig. 28. The concrete foundation for the turbine is 12 ft. square at the floor level and 15 ft. square at the ground level. It is 10½ ft. high, and the turbine stands 17½ ft. high above that. This unit was placed in use last April, and has been in constant service on the daily peak of the load ever since. Its operation has been very satisfactory. Another

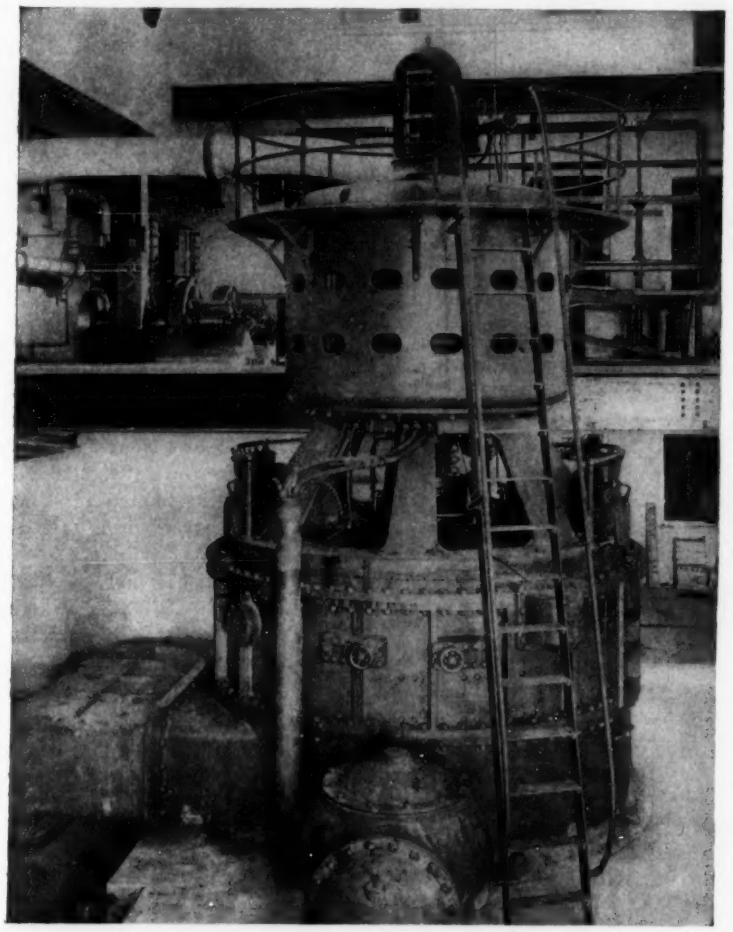


FIG. 28.—2,000-KW CURTIS STEAM TURBINE IN LOS ANGELES STATION NO. 3, EDISON ELECTRIC COMPANY.

unit of the same capacity has been ordered, and is ready for installation, its foundation already being in place.

The condensing apparatus for the turbine unit consists of a surface condenser of the marine type made by the Wheeler Engineering Company and a centrifugal circulating pump, motor driven. The air pump is of the Edwards triplex type, and is driven by a 30-hp. induction motor. The condensers discharge through a vertical tube into the cooling tower passage, 5 ft. 9 in. wide, which is located in the gutter space between the two parts of the building. The cooling tower is situated at the west side of the building, and has a large cooling area.

Under the switchboard gallery at the end of the room are located the brick-cell oil switches for the machine. On the gallery floor proper are two engine-driven exciters, and the switchboard apparatus, the latter being of the remote control motor-driven type. The controlling switchboard is at the edge of the gallery, and is arranged so that the operator can overlook the turbine room.

The design of the sub-station part of the building embraces many novel features, most of which are necessitated by the variety of circuits which it will control. There are to be four sets of double bus-bars, two each for 60,000, 30,000, 15,000 and 2,300 volts. Power will be received at 60,000 volts from the Kern River country over lines running from 116 miles in length upward. The main 30,000-volt line from the Santa Ana and Mill Creek power houses passes by the station and taps into it, and distribution throughout the city and immediate vicinity will be at 15,000 volts. It will be possible to connect any of these bus-bars of different voltages together through the transformers, thereby distributing power to the point where it is most required; and the whole of it may be supplemented by the 2,300-volt steam turbine plant above described, or any portion of it can be separated from the rest and driven by steam. This makes a very flexible arrangement for a very complicated purpose.

The substation part of the building occupies two wings on the east side, the one next the turbine room being used as a high-tension switching house, and the outside wing as a transformer house. Each portion is entirely enclosed by concrete walls. The high-tension switching house has three floors and a gallery. The upper floor will be used for the 60,000-volt Kern River lines, the next for the 30,000-volt circuits, and the two lower floors for the 15,000 and 2,300-volt circuits. The transformer room is 30 ft. wide, and is divided transversely into a number of stalls with an 8-ft. alleyway at the outside wall. The transformers will be set in the stalls, and will be separated by fire-proof brick partitions, 22 ft. long and 22 ft. high, with an additional raise of 10 ft., 6 ft. in width, at the back so as to protect the wiring on the wall. At present three 700-kw. water-cooled, oil-insulated transformers are used in connection with the steam turbine.

The Schloemilch Electrolytic Detector.

BY A. FREDERICK COLLINS.

THE Gesellschaft für Drahtlose Telegraphie, Berlin, Germany, or in other words, the wireless trust, which controls the Slaby-Arco and Braun-Siemens & Halske systems of space telegraphy, has recently brought out another type of detector, the new one being similar to those now used by the Fessenden and De Forest interests in this country.

The announcement of the commercial application of the detector designed by Schloemilch is at the present time especially interesting, for its popularity is so great that there are now no less than four distinct claimants to the discovery of the principles upon which it is based.

Its construction and its operation, although the latter is a mooted question, is precisely like that first described by Fessenden in a United States patent, dated May 5, 1903, the number being 727,331, and termed by him a liquid barretter, and which I abstracted for the ELECTRICAL WORLD AND ENGINEER September 19, 1903, and is quite similar to the detector which the De Forest Company is now supplying with its equipments, and which Dr. James E. Ives so ably elucidated in the same publication in the issue of December 10, 1904.

The Schloemilch receiving apparatus, using an electrolytic detector, as it is termed, in connection with a telephone receiver, is claimed by those responsible for its appearance on the market to be the most highly developed of all acoustic receptors used in wireless telegraphy. The certainty of its operation, its great sensitiveness, the astonishing simplicity of its manipulation will earn for it a place in every modern wireless telegraphic installation.

The instrument is not limited in its application to the reception of wireless signals, since it may also be employed in measuring radiant energy and determining wave lengths of widely separated stations between which communication is impossible with the ordinary receiving apparatus. The complete apparatus for receiving and translating the electric energy of the waves into audible sounds consists essentially of the detector in question, a telephone receiver and a source of electrical energy; these three principal elements are connected in series in a single circuit.

Since the tension of the current must be subject to regulation to obtain the maximum effects, a potentiometer or variable resistance is connected in parallel with the four elements of the dry battery, and from this resistance a shunt leads to the terminals of the detector. When in operation the electric oscillations vary the resistance of the cell—the different theories formulated having been discussed by Dr. Ives in the paper above referred to—and thus in consequence the strength of the local is increased or diminished when sounds are heard in the telephone receiver. In order to insulate or protect the detector from waves emitted by its own station it is

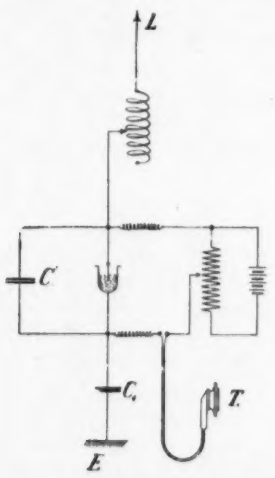
not necessary to enclose it in a grounded metallic box as in the case of the coherer; the wire or line leading to the receiving wire and the wire leading to the cell are merely cut out by a switch during the period of transmitting signals and switched in during the time it is desired to receive.

By means of a cut-out in the primary or internal circuit, which is mounted on the same switch lever, an additional precaution is provided to prevent the transmitting system from being influenced as long as the detector is switched in and the aerial is electrically connected with the apparatus. So little affected is this type of detector by vibration, messages may be clearly received even though, as Prof. Fessenden tersely put it, the table is being pounded with a hammer.

The adjustment of the apparatus is effected by connecting up the battery, the telephone and the detector and then increasing the potential by means of a sliding contact on the variable resistance until a slight audible vibration is produced by the telephone. If the potential of the local cells is reduced very slightly these sounds will disappear; when this point has been reached the detector may be regarded as having attained its maximum sensitiveness.

The Schloemilch detector is made with two degrees of sensitiveness, the first being more powerful acoustically—that is, the signals are rendered quite loud and distinct, but owing to the comparatively large cross section of the platinum wire immersed in the dilute solution of sulphuric acid the sensitiveness is much reduced. The second is acoustically less powerful, but the detector has an exceedingly fine wire and its sensitivity is therefore greatly increased. The makers place a distinguishing mark on the bottom of each detector cup, thus, *E* (empfindlich = sensitive), or *H* (hochempfindlich = highly sensitive).

The most suitable circuits for this detector in the high-frequency or resonator system are shown in the accompanying diagram. The aerial, *L*, after the apparatus has been connected up and grounded, is attuned by cutting in the inductance coils and by means of the variable capacity, *C*, and an auxiliary condenser, C_1, which has also



SCHLOEMILCH ELECTRIC WAVE DETECTOR AND CONNECTIONS.

been found useful. Tuning is continued until the telephone, *T*, has reached its greatest amplitude of vibration; the value of the condenser, *C*, which is connected in parallel with the detector, as well as that of inductance, depends upon the length of wave emitted by the sending station as well as on the electrical properties of the receiving wire, which should be syntonized with it. If the energy of the oscillations set up by the received waves is very greatly diminished, after the process of tuning the variations may be materially augmented by a very careful readjustment of the sliding contacts on the variable resistance.

The detector designated by the letter *E* is employed under normal conditions; the condenser connected in parallel with this detector has an average capacity of 200 to 400 cm. For the inductance of the aerial a suitable coil of wire with sliding contacts is used. The detector marked with the letter *H*, owing to the very feeble audibility of the signals, is cut in only when the energy is decreased to a point where calculations with the former would be practically impossible. With this detector a condenser of 150 to 200 cm. capacity is connected in parallel. In tuning particular attention should be paid to obtain as nearly perfect simple resonance in the currents as possible, and it is easy in changing the capacity of the condensers and the inductance of the turns of wire to exceed the critical points.

The origin of this type of detector is of very recent date, but it seems to be shrouded in as much mystery as the building of the pyramids. For instance, the first reference to it that I have been able to find is that embodied in the United States patent specification issued to Reginald A. Fessenden on May 5, 1903, No. 727,331. In this patent Fessenden discloses the construction and presents his theory of its operation based on the fact that "the energy of the waves is utilized to heat a body of small mass and hence requires a small amount of energy to be heated to such an extent as to change its electrical conductivity."

This statement referred more particularly to his hot-wire barretter which, it will be remembered, comprised a silver wire of small diameter having a core of platinum wire and both drawn down until the outer covering of silver was approximately 2/1000 of an inch and the platinum was 6/100000 of an inch in diameter, but, as Fessenden points out, "the specific resistance of liquids is much higher than of metals and to obtain the same resistance a very much smaller mass, which is capable of being heated to a much larger extent, may be used."

In November, 1903, Herr W. Schloemilch published an account of his researches and Mr. F. K. Vreeland, in his book, "Maxwell's Theory and Wireless Telegraphy," published in 1904, lays claim to having discovered the device in the following words: "Another electrolytic detector was developed by the writer [Vreeland] in the course of a series of attempts to magnify the heating effects of Fessenden's barretter by immersing the wire in a liquid of high temperature coefficient and low specific heat, which was made a part of the local circuit.

"The attempt was unsuccessful, but it led to the discovery that a simple electrolytic cell when polarized to the proper critical point by the current from a local battery is remarkably sensitive to oscillatory impulses." Here a footnote states that "since the above went into type an announcement has been published of the independent discovery of this principle by Schloemilch in Germany, the detector that he describes being almost identical with the above." This indicates, then, that Mr. Vreeland made the discovery prior to November 19, 1903.

"Furthermore," Mr. Vreeland adds, "the effect is quite distinct from that involved in the De Forest responder, for the platinum anode, minute as it is, is not attacked by the electrolyte, and the electrolyte itself is a good conductor; moreover, the apparent resistance of the cell falls on the passage of the oscillations, instead of rising.

The De Forest responder to which Mr. Vreeland refers is the one issued to De Forest and Smyth, No. 716,000, December 16, 1902, and describes a type of detector in which the electrolytic action of a low-voltage direct current causes minute metallic threads to form between the terminals of the conductor plugs, and which is disrupted by the high-frequency oscillations, hence the responder has normally a low resistance, which is increased by the effect of the oscillations.

The detector now used in the De Forest receiver is to all intents and purposes similar to those described by Fessenden, Vreeland and Schloemilch, and the fact that there are so many claimants of such recognized ability leads us to suspect that it would be hard to duplicate the instrument. To some one of these physicists must belong the honor of having invented this cell, for it is quite unlikely that the idea was received telepathically from out of the transcendent ether simultaneously, nor again that one worker so concentrated his mind that the other three were mentally impressed with an image of it, since there is nothing on the surface of the subject to indicate that their minds were or are now in syntony one with the other.

New Storage Battery.

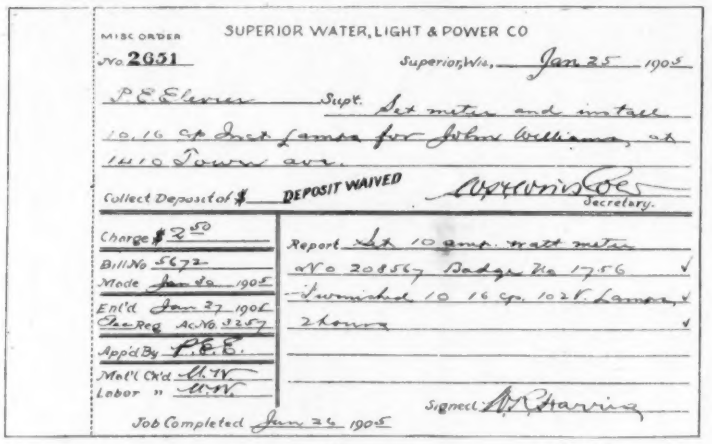
According to the *Genie Civil*, M. Jeantaud has devised a storage battery which, with plates of the usual structure, employ a paste of allotropic oxide of lead instead of the ordinary oxide. The new plates, it is claimed, give an e.m.f. 5 per cent. above that of the usual lead battery, and a capacity double as great. A cell weighing 25 pounds, including case and electrolyte, gave a discharge of 36 amp. during 6 hours and 34 minutes, at the end of which time the e.m.f. was 1.7 volts. The output was 88 watt-hours per pound of material. A battery weighing 770 pounds drove a coupé weighing, with battery, 2,750 pounds, 60 miles over bad roads on one charge.

The Credit Question in Central Station Management.

BY W. H. WINSLOW.

CONDITIONS in different places vary so greatly that, manifestly, no one credit system can be of general application. In old communities where there is little growth or change, deposits to secure accounts may safely be dispensed with, save in exceptional cases, while on the other hand there are places where deposits must be the rule rather than the exception. Both of these extremes simplify the credit question almost to the vanishing point, but there are many places where no deposits would mean heavy losses and where the exacting of them in all cases would cause great dissatisfaction. In such cases the method here outlined may prove of some value.

All orders for the opening of accounts are made out on Form 1 and turned over to the credit man to be passed on and signed. If


MISC ORDER SUPERIOR WATER, LIGHT & POWER CO

No. 2651 Superior, Wis., Jan 25 1905

P. E. Elsner Supt. Set meter and install 10, 16 cp Inst Lamps for John Williams, at 1410 Town ave.

Collect Deposit of $ DEPOSIT WAIVED Secretary.

Charge $2.50
Bill No 5672
Made Jan 26 1905
Ent'd Jan 27 1905
Chas Reg Ac No 3257
Appd By P. E. E.
Mat'l Ch'd H. W.
Labor " H. W.

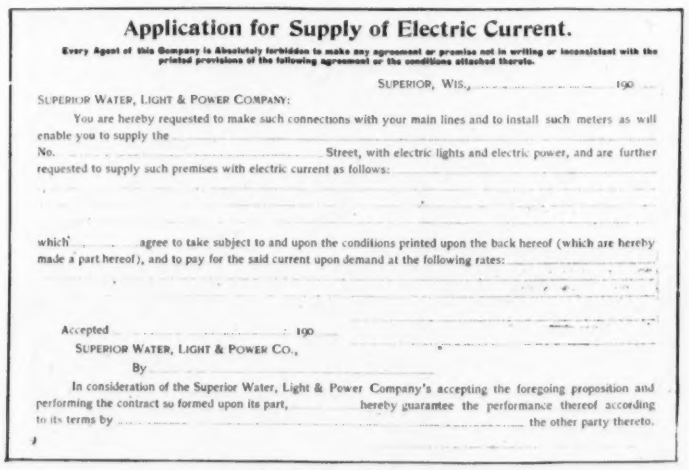
Report Set 10 amp watt meter No 204567 Badger No 1756 ✓
Furnished 10 16 cp 102 V Lamps ✓
2 Hours ✓

Signed H. W. Harring

Job Completed Jan 26 1905

FIG. 1.—FORM 1, MISCELLANEOUS ORDER, SIZE 5" x 8".

the applicant is unknown, or if what is known of him is unfavorable, the amount of deposit to be collected is inserted and the order given to the superintendent. Should the latter possess any knowledge which leads him to suppose that the applicant is deserving of credit or that the sum to be collected is either more or less than sufficient, he returns the order with his recommendation for correction; otherwise, he attaches to it an application blank (Form 2) and a deposit


Application for Supply of Electric Current.

Every Agent of this Company is Absolutely forbidden to make any agreement or promise not in writing or inconsistent with the printed provisions of the following agreement or the conditions attached thereto.

SUPERIOR, WIS., ... 190

SUPERIOR WATER, LIGHT & POWER COMPANY:

You are hereby requested to make such connections with your main lines and to install such meters as will enable you to supply the ..... No. ..... Street, with electric lights and electric power, and are further requested to supply such premises with electric current as follows: .....

which ..... agree to take subject to and upon the conditions printed upon the back hereof (which are hereby made a part hereof), and to pay for the said current upon demand at the following rates: .....

Accepted ..... 190 .....

SUPERIOR WATER, LIGHT & POWER CO.,

By .....

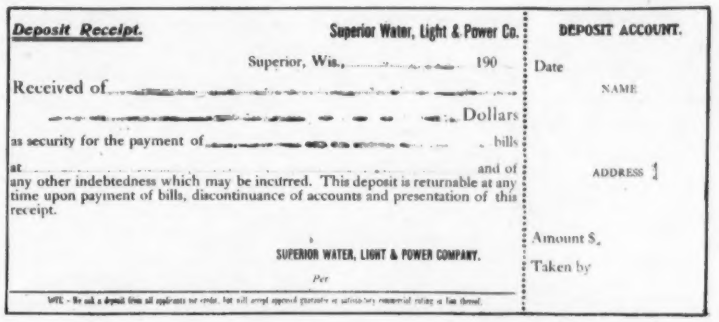
In consideration of the Superior Water, Light & Power Company's accepting the foregoing proposition and performing the contract so formed upon its part, ... hereby guarantee the performance thereof according to its terms by ..... the other party thereto.

FIG. 2.—FORM 2.

receipt (Form 3) and turns the whole over to one of his men after making a record of the number of the order and to whom given.

If, when the application is presented any objection is made to putting up a deposit, attention is called to the note at the bottom of the deposit receipt and the applicant requested to call at the office. In cases where no deposit is deemed necessary, "Deposit Waived" is imprinted on the order before it is turned over to the superintendent. It will be seen that deposits are asked for in all doubtful cases, but that an opportunity is afforded each applicant to give references or to otherwise demonstrate his right to receive credit. This absence of an arbitrary and unqualified demand for a deposit seems to make its collection much easier and to obviate a great deal of unpleasantness.

In determining the amount to be collected applicants may, roughly speaking, be divided into two classes; first, all those whose occupations or antecedents are of a more or less shady character, or whose business calls for little or no investment, and who are required to put up a sum equal to an estimated two months' bill; second, a class


Deposit Receipt. Superior Water, Light & Power Co. DEPOSIT ACCOUNT.

Superior, Wis., ... 190 Date

Received of ..... NAME

..... Dollars

as security for the payment of ..... bills

at ..... and of ADDRESS

any other indebtedness which may be incurred. This deposit is returnable at any time upon payment of bills, discontinuance of accounts and presentation of this receipt.

SUPERIOR WATER, LIGHT & POWER COMPANY. Amount $,

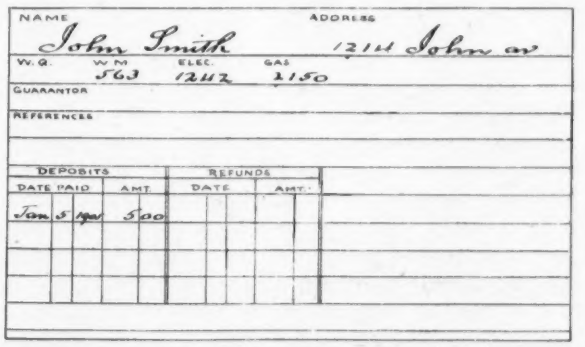
Per Taken by

NOTE.—We ask a deposit from all applicants not credit, but will accept approved guarantee or satisfactory commercial rating as has thereof.

FIG. 3.—FORM 3, DEPOSIT RECEIPT, SIZE 4" x 8½".

made up largely of tenants of small houses or flats who are generally asked for from three to five dollars, the idea being not so much to prevent deliberate fraud as to insure their looking up the company when they move instead of the company's having the frequently unprofitable and fruitless task of locating them. It may be objected that the plan here outlined involves the expenditure of considerable time. It does take time, of course, but it is believed that it will result in sufficient saving in the bad debt account on the one hand and prevention of friction on the other, to more than justify the expenditure. The good will of the community, while not as essential to a lighting company as to a merchant, is still a valuable asset and, when one considers how much more one dissatisfied consumer will say against a company than fifty pleased ones will say for it, the value of anything which tends to lessen the number of the former should be apparent.

As deposits are collected they are posted from the blotter cash to a regular ledger account, "Consumers' Deposits," and to a card


NAME John Smith ADDRESS 1214 John av

W. Q. W M 163 ELEC. 1242 GAS 2150

GUARANTOR

REFERENCES

DEPOSITS		REFUNDS	
DATE PAID	AMT.	DATE	AMT.
Jan 5 1905	5 00		

FIG. 4.—FORM 4, CARD INDEX, SIZE 3" x 5".

index (Form 4), this latter serving both as an aid to the credit man in handling delinquent accounts and as an index to the ledger account for use in posting refunds.

The "Miscellaneous Order" illustrated (Form 1) is used for a number of purposes, among which are: Set meter, remove meter, change account (from one name to another), change meter, count lights, connect motor, recount lamps, and in fact for anything of which it is desired to preserve a record. While the employment of the one form for such a diversity of uses would not perhaps be advisable for a very large company, it has advantage over a number of forms for smaller concerns. It is also doubtless true that the credit methods here described would scarcely be applicable in a large city where a more arbitrary system is a virtual necessity. It is always possible, however, to couch what is practically a demand in the form of a request.

The Electron Theory.

In a paper presented before the electrical section of the Western Society of Engineers, Prof. Crew, of Northwestern University, said that the electron theory, as it stands to-day, is merely a first step toward a more complete description, based strictly upon experimental evidence. At the same time, the ionic hypothesis is the only one which has shown any degree of competency whatever.

The London Underground Electric Railway Company's System.

THE Underground Electric Railways Company, of London, was incorporated in 1902 for the purpose of supplying power to a number of electric railways in London. Of the total length of 83.6 miles of double track of the five independent roads to which power will be supplied, 56 miles belongs to the Metropolitan District Railway, while 10.4 miles belongs to the Great Northern, Piccadilly & Brompton Railway.

Practically all of the power necessary for the above roads will be obtained from the Chelsea generating station, which is now nearing completion (Fig. 1). The main building is entirely of fire-proof construction, without ornamental features, and consists of a self-supporting steel frame weighing about 6,000 tons, enclosed with brick and terra cotta. The building is arranged for ten 5,500-kw turbo-alternators and one split unit of 2,700 kw, a total normal full load capacity of 57,700 kw.

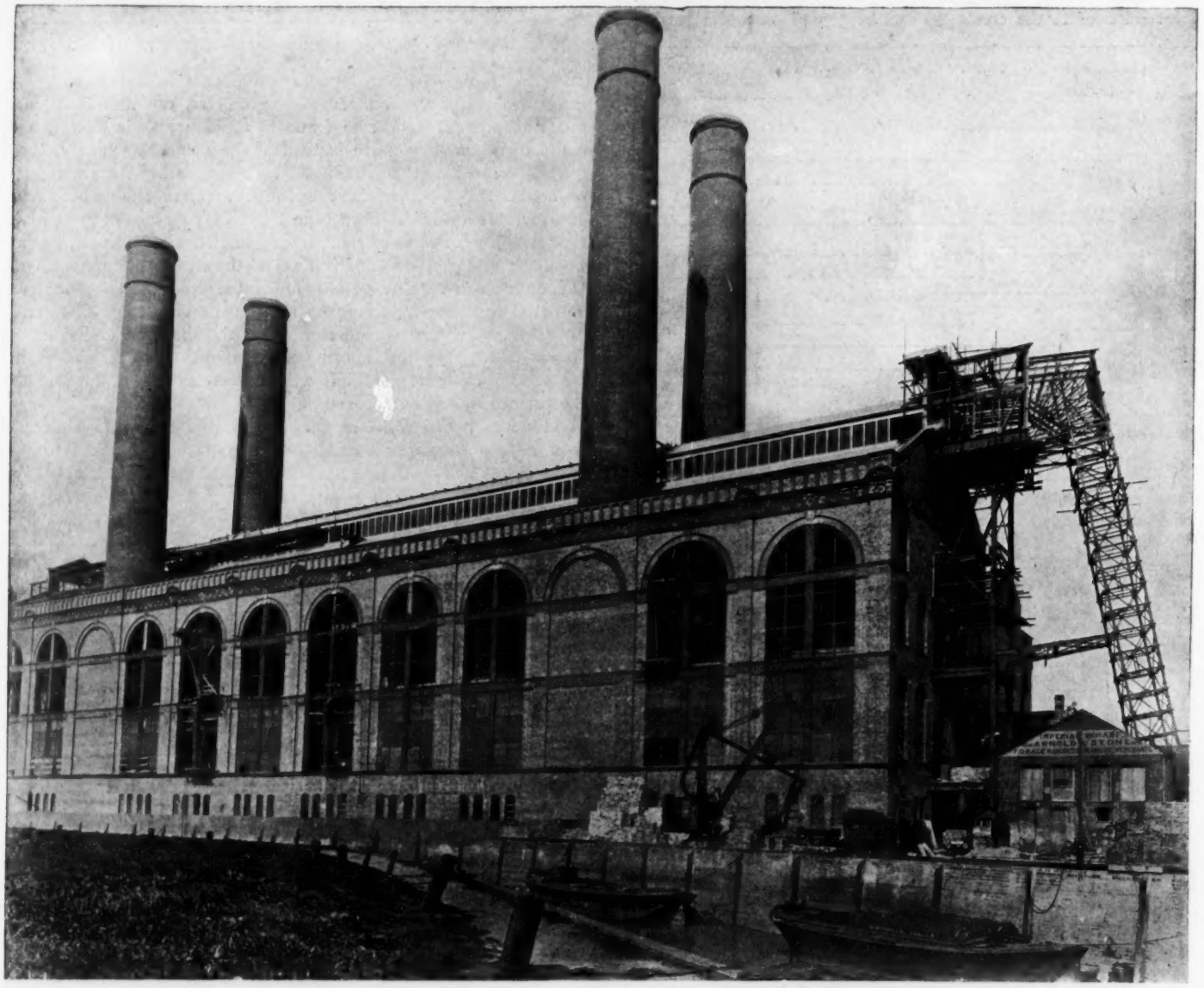


FIG. 1.—CHELSEA GENERATING STATION, UNDERGROUND ELECTRIC RAILWAY COMPANY, LONDON.

The boiler room is designed for an ultimate equipment of 80 B. & W. horizontal water-tube boilers, each having 5,212 sq. ft. of heating surface and 672 sq. ft. of superheating surface. The working pressure is 175 pounds, with 150° of superheat. Each boiler is fitted with two electrically-operated B. & W. chain grate stokers, the two grates having 85 sq. ft. of surface. Green economizers are installed, these being constructed with tubes farther apart than the usual practice and arranged in nests behind each group of boilers with the usual bye-pass flues, 1,540 sq. ft. of heating surface being provided for each boiler. Vertical condensers, each with 15,000 sq. ft. of cooling surface, are located in pits between the engine foundations, and are designed to work on the dry vacuum principle.

The turbo-alternators are of Westinghouse manufacture, and consist of a single-cylinder, double-flow, steam turbine connected through a flexible claw coupling to a revolving-field generator (Fig. 2). The present installation will consist of eight units, the normal full load being 5,500 kw, with a guaranteed overload capacity of 50 per cent. for two hours. At full non-inductive load each alternator delivers 289 amp. per phase at 11,000. These are three-phase, four-polar machines driven at 1,000 r.p.m., and, therefore, the circuit frequency is 33⅓ cycles per second. The guaranteed electrical efficiencies of these machines at full non-inductive load is 97.25 per cent., the regulation is 6 per cent. and the maximum temperature rise 35° C.

Each of the four exciter sets consists of a 125-kw, 125-volt, British Thomson-Houston compound-wound generator, driven at 375 r.p.m. by direct connection to a 200-hp compound two-crank, double-acting engine. The auxiliary electrical installation includes one 125-kw synchronous motor-generator set, nine single-phase, 11,000 to 220-volt transformers, aggregating 1,500 kw, and two small 125-volt storage batteries. The motor-generator sets will be used primarily for charging the storage batteries, and will supply direct current for miscellaneous purposes. The transformers supply power to motor-generator sets and to the 220-volt, three-phase induction motors operating the various pumps, coal-handling machinery, stoker mechanism, etc. The oil switch motors are driven by current from the small storage batteries.

The general arrangement of the high-tension switching apparatus provides that any of the generators, group switches or individual sections of the main bus-bars may be shut down without seriously interfering with the operation of the system. All of the main and auxiliary switchboard equipment is of the standard General Electric Company's design, and has been supplied by the British Thomson-

FIG. 2.—VIEW OF INTERIOR OF CHELSEA POWER STATION.

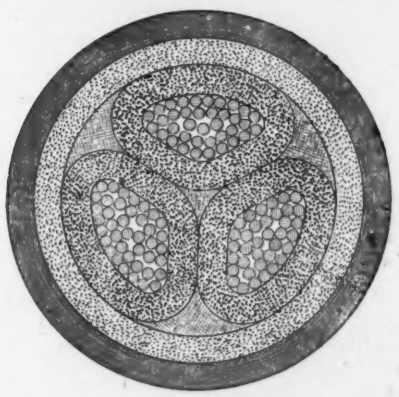


FIG. 3.—11,000-VOLT CABLE.

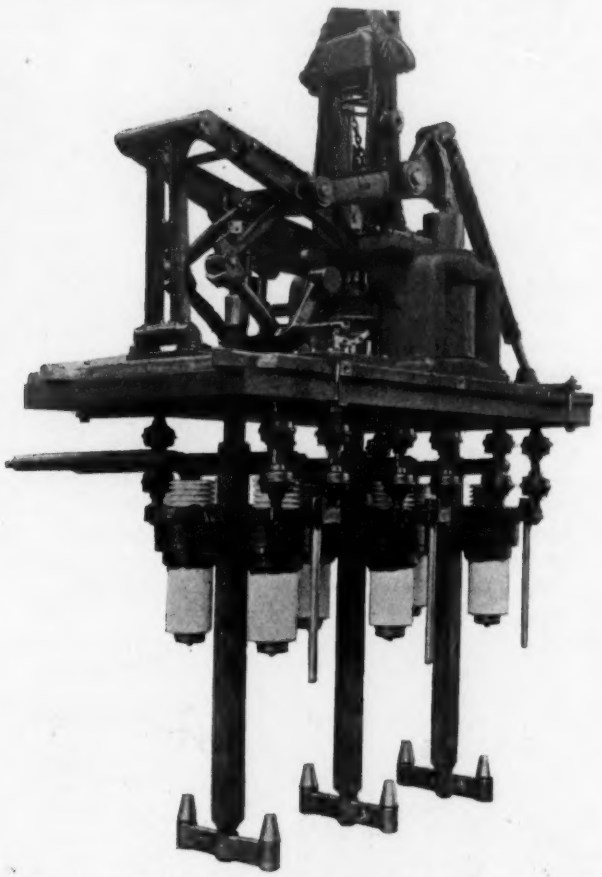


FIG. 5.—HAND-OPERATED OIL-BREAK SWITCHES FOR SUB-STATIONS.

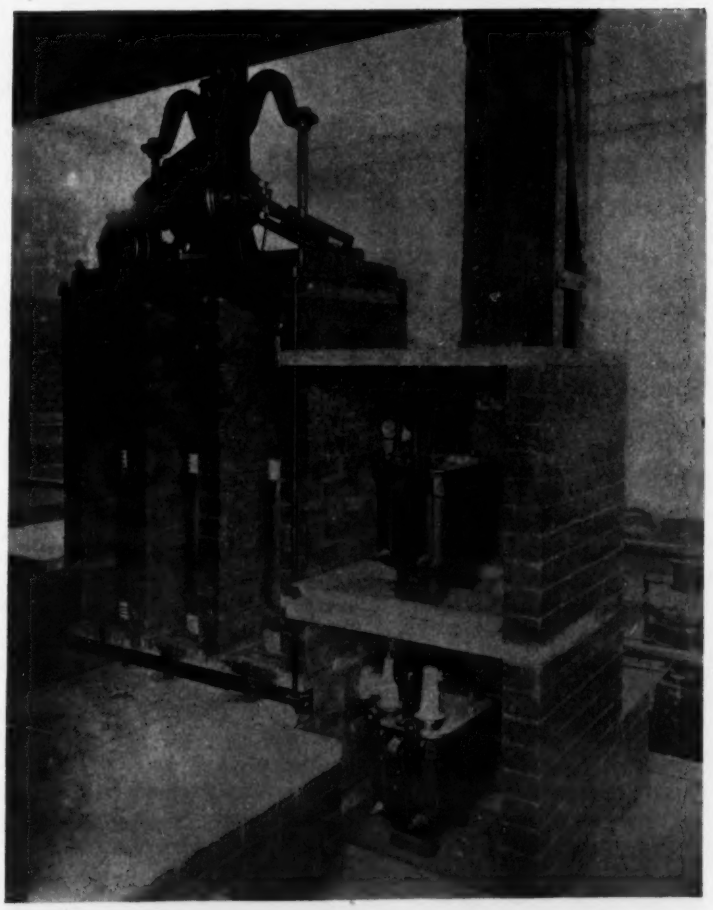


FIG. 4.—OIL SWITCH AND POTENTIAL TRANSFORMERS, CHELSEA STATION.

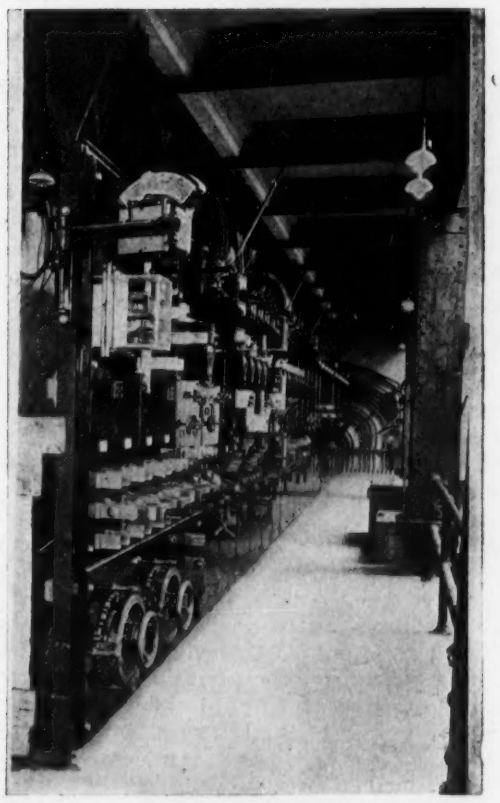


FIG. 6.—SWITCHBOARD FOR AUXILIARY PLANT.

LONDON UNDERGROUND ELECTRIC RAILWAY COMPANY'S SYSTEM.

Houston Company. Motor-operated, type H oil switches are used for the control of all 11,000-volt, alternating-current circuits. The generator bus junction and group switches are non-automatic and entirely under the control of the operator. The generator switches are equipped with one reverse-current relay designed to light a signal lamp should any generator fail, but not to operate the switch automatically. The automatic reverse-current feature can, however, be made operative at any time should it seem desirable.

The individual feeder switches, which are the only automatic high-tension oil switches, are equipped with overload time-limit relays. The time feature is obtained by an air dash so designed as to allow the relay contacts to close instantly in case of short-circuit, while a moderate overload will only close the contacts after an adjustable time limit of several seconds. A relay is connected in each of the three phases of each high-tension feeder so as to provide for operation with the neutral point earthed, and to take care of any possible breakdown between conductors and the lead sheath. The three relay contacts are connected in parallel to supply the motor of the corresponding oil switch and, therefore, a breakdown to earth of any one of the three phases will completely disconnect the feeder at the generating station end.

Each phase of every high-tension circuit, whether in the oil switches or bus-bars, etc., from the alternator terminals to the end bells of the individual feeders, is completely separated from the others by either brick or stone barriers. (See Fig. 4.) Soapstone slabs are used for the oil switch settings, moulded stone and brick being used exclusively in the construction of the switch and bus-bar compartments and for all high-tension barriers.

FIG. 7.—MOTOR CAR.

Small iron doors for inspection and maintenance are provided in the construction of all bus-bar chambers opposite the bus-bar isolating switches and supports and for all potential transformer compartments and oil switches. Protection doors are also provided for the static dischargers and all exposed interconnecting cables and terminals between the feeder bus-bars and oil switches. The three main high-tension switchboard galleries run the entire length of the building and are extended across the office end of the building for the auxiliary station transformers, motor-operated generator, rheostats and auxiliary switchboard.

The generator and feeder instrument and control boards are located in the center of the house on the middle switchboard gallery, all high-tension apparatus being controlled from this point. The usual red and green indicating lamps are provided on both the generator and feeder control boards to indicate that the corresponding switch is closed or open. A large electric gong is mounted on the controlling circuit panel in connection with each feeder switch control circuit, so as to provide an audible signal for the operator, in addition to the indicating lamps, when the feeder switches open.

The auxiliary switchboard (Fig. 6), which is installed on the lower end gallery, consists of two battery, two direct-current feeder, two motor-generator, one load, four exciter and thirteen alternating-current panels, a total of twenty-four panels. The exciter bus is sectionalized into two parts, so that continuous service can be given by the plant while alternations are being made on either part of the bus at times of light load. Emergency switches are provided so that current for operating the oil switch motors may be obtained from either the motor-generator or one of the exciters in the event of accident to either or both batteries.

The high-tension, three-phase cables are installed in duplicate, with one exception, between the generating station and each sub-station, the total final installation aggregating about 365 miles. Three-core, paper-insulated, lead-covered cables are installed, the conductors being of the standard English or "clover leaf" pattern (Fig. 3). They are subjected to a pressure of 33,000 volts at the factory, and again tested at 22,000 volts after being laid and jointed. Three sizes of cables are used, the sectional area in square inches of each conductor being .15, .19 and .25, respectively. The thickness of insulation between conductors and between conductors and earth is 7/16 in., and the thickness of the lead sheathing is 3/16 in.

The Chelsea generating station will supply power to a total of 24 sub-stations, situated an average of 6.67 miles from the generating station, and containing 77 rotary converters with an aggregate capacity of 87,500 kw. The rotary converters are of standard Westinghouse design, containing direct-connected starting motors, compound-wound field coils and copper damping shields on the pole tips. The power transformers are of the vertical air-blast type, each transformer being provided with a number of taps on the primary winding for adjusting the ratio of transformation, so that the potential delivered to the rotary converters shall be essentially the same in all sub-stations. The transformers are delta-connected on both sides, the three transformers with the corresponding rotary being operated as a unit. Two 11,000 to 220-volt, single-phase, 150-kw air-blast transformers are installed in the majority of the sub-stations, so that the station and tunnel lighting will be practically independent of the power circuits from the sub-stations.

The high-tension, oil-break feeder and rotary switches are operated by hand through the medium of levers suitably connected to the switch proper by a link mechanism similar to that used in railway signal work. Each pole of these switches is erected in a separate fire-proof masonry compartment. There are two stationary contacts per pole, one connected to the incoming and the other to the outgoing lead of the same phase, while the movable contact for each pole consists of a V-shaped copper piece fastened to the end of a stout wooden rod. The wooden rods are fastened at their upper ends to a common cross bar, which is given a vertical motion by the link mechanism. (See Fig. 5.) The feeder and rotary switches are automatically tripped by reverse-current and overload, time-limit relays connected to the series transformers in the main circuits. The rotary switches can also be electromagnetically tripped by a push button on the rotary panels.

One-third of the total number of sub-stations supply current to two or more independent railways, making it necessary to meter separately the power supplied to each road whether for traction, tunnel and station lighting or for lifts. The use of an insulated return, in addition to these metering requirements, makes the construction and operation much more extensive and complicated than is usually the case for this class of work.

Duplicate motor-generator sets and an air compressor equipment are installed in each sub-station for the operation of the signal system. Each motor-generator set consists of a 7.5-kw, 70-volt, compound-wound, direct-current generator mounted on a common shaft with a three-phase, 365-volt induction motor, which obtains its current from the transformers for the rotary converters.

The tunnels and stations generally will be lighted by incandescent lamps supplied from the three-phase, 220-volt mains. The distribution system is arranged for emergency interconnection between sub-stations. All "tube" passenger stations will, in addition, be p--

vided by an independent lighting system from some outside and entirely independent source, these emergency lights to be in continuous service.

Two insulated conductor rails, positive and negative, are used per track, the former being placed 16 in. outside the running rail and the latter centrally between the track rails. They are 3 in. and 1½ in. respectively above the running rails. The material of these rails has been selected with especial reference to its conductivity. From actual tests it was found that the relative resistance of this conductor rail, six months after being bonded for service, including bonds, etc., was 7.76 to 1 compared with Matthieson's standard of conductivity.

The Westinghouse electro-pneumatic system of automatic signaling and power interlocking have been adopted. The power interlocking is similar to that installed in the United States, one of the more important differences being in the switch lay-outs. Each signal is provided with an automatic train stop. When the signal goes to danger the stop arm is raised to a vertical position near the right-hand running rail. Should a train attempt to pass a signal at danger, this arm would engage with and open a cock on the train causing an emergency application of its brakes. When the signal indicates clear the stop arm is lowered, allowing the train

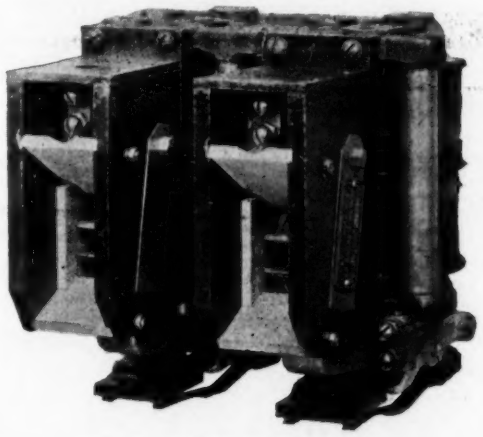


FIG. 8.—STANDARD CONTACTOR.

to pass. The track circuit system is selective between the normal signal and extraneous currents, the operation of the signals having been in no wise interrupted by repeated and extensive flooding of the tracks.

A magazine train describer is being installed in connection with the signal system, the line between the sending and receiving stations having a capacity varying from five to twenty trains. There will be erected on each station platform illuminated signs to indicate the next three trains in the order of their arrival. The departing train cancels its own description, the remaining two descriptions moving up simultaneously with a new announcement. It is expected that this method of announcing arriving trains will greatly facilitate the loading and thereby shorten the stops at the station.

The Board of Trade regulations in regard to "tube" railways do not permit the use of a motor car in the center of the train, and therefore each tube train has but two motor cars, one at either end of the train. The cars for the tube railways will be of steel construction throughout, and equipped with the usual platform gates. The district cars are constructed of wood thoroughly treated to render them absolutely fire resistive. The platforms of these cars are entirely enclosed, and they are constructed with side and end sliding doors. Double sliding doors are provided in the middle of the car so that the entering passengers will not be delayed by the ones leaving by way of the end doors (Fig. 7). All side doors are opened and closed by compressed air controlled by a lever on the end of the car.

The motor equipment of the train consists of standard 200-hp General Electric 69 motors using the type "M" control. There is placed at one end of each end motor car, and at both ends of each middle motor car, a master controller, which operates the motor controlling contractors and reversers. As seen in Fig. 8, the contractors are quite compact and well designed. The master controller is manually operated and non-automatic, and is so designed that, in case the motorman removes his hand from the operating handle for any cause, the control circuit will be opened, thus shutting off all power from the train and applying the air brakes. By use of the so-called bridge method, the change from series to parallel combination of motors is effected without interrupting the current in either motor, thus eliminating entirely the somewhat unpleasant sag in speed which is noticed in the more usual methods of control.

All work in connection with the electrification of the Metropolitan District and other railways controlled by the Underground Electric Railway Company, is being executed under the direction and personal supervision of Mr. James R. Chapman, general manager and chief engineer. The electrical engineer for the company is Mr. S. B. Fortenbaugh, from whom the facts which are presented above have been obtained.

Commutation of Direct-Current Machines.

Two patents issued February 28 to Mr. F. M. Young and two to Mr. G. S. Dunn, all four being assigned to the Crocker-Wheeler Company, have for their common object to improve the present method of commutation in direct-current machines by increasing the resistance in the path of the current from the live brush into the advancing terminal of the commutating coil without increasing the resistance between the live brush and the trailing terminal of the commutating coil, the object being to

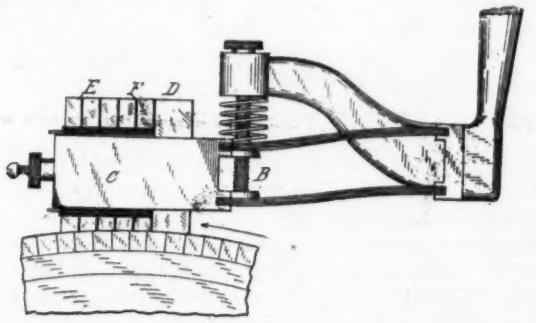


FIG. 1.—END VIEW OF BRUSHES.

accelerate the reversal of the current in the coil. For this purpose the inventors use auxiliary "dead" brushes, which are insulated not only from the live brush and its holder, but from every other part of the machine, so that they are completely dead except for their contact with the commutator bars. In the accompanying illustrations *D* is the live brush, while the dead brushes are represented by *E*, the insulation surrounding each of the dead brushes being indicated by the letter *F*.

Referring to Fig. 3, coil *a* is receiving current from its left-hand or leading terminal, which flows out at the right-hand or trailing terminal and into the coils to the right. When the coil *a* reaches the

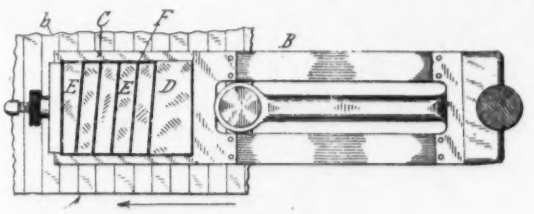


FIG. 2.—TOP VIEW OF BRUSHES.

position of coil 1, it is short-circuited through the live brush, but owing to the inductance current continues to flow in the same direction as before, although of a diminished value. When the coil *a* reaches position 2, it is short-circuited through a dead brush, and current tends to flow from the live brush in at the trailing terminal; but this, which would effect a reversal of the current in the coil, is opposed by the self-induction thereof.

Current also tends to flow from the live brush and in at the leading terminal; but this is opposed by the two additional surface contacts between the commutator bar and the first dead brush and this brush and the next commutator bar. As the coil *a* moves to the left the facility for receiving current at the leading terminal is progressively diminished because of the increasing number of con-

tact surfaces through which such current has to pass. On the other hand, the facility for receiving current at the trailing terminal from the coils to the right is not diminished, and, therefore, the tendency is for the current in the coil to be reversed gradually. As seen in Fig. 2, the planes of separation between the brushes are inclined

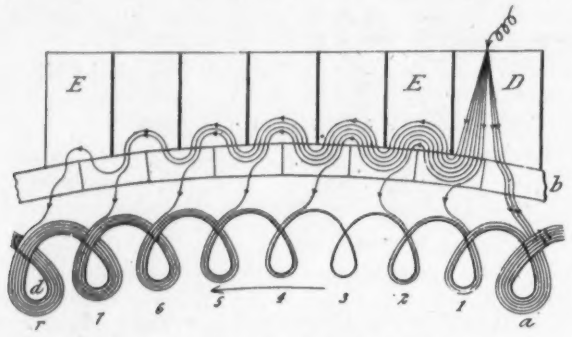


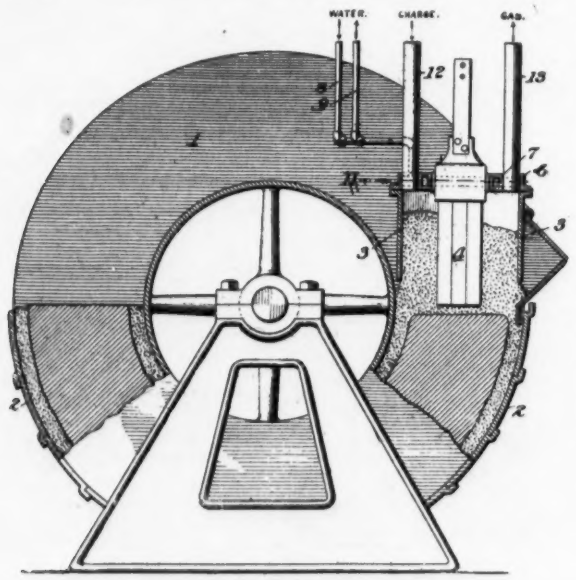
FIG. 3.—DISTRIBUTION OF CURRENT IN COILS.

relatively to the strips of mica on the commutator for the purpose of preventing an instant of absolute rupture of the commutating current when the trailing side of the live brush leaves the commutator bar, thereby avoiding any sparking at the brushes or burning of the commutator bars. An effect to be noted due to this method of commutation is that not only into the advancing terminal of one but into the advancing terminals of a number of successive coils a gradually-increasing resistance is introduced in such a way that at each terminal a resistance of different amount to that at any other terminal is produced at a given time, forming as many paths of current as there are different resistances.

Recent Electrochemical Developments.

ELECTRIC FURNACE FOR THE PRODUCTION OF CALCIUM CARBIDE.

Two patents were recently granted for electric furnace constructions for the production of calcium carbide, both being assigned to the Union Carbide Company, the sole producer of calcium carbide in this country. Mr. J. M. Morehead's construction, illustrated below,



CALCIUM CARBIDE ELECTRIC FURNACE.

is a modification of the revolving Horry furnace, the working chamber of which consists of a wheel, 1, with removable cover-plates, 2. An iron hood, 3, depends into the open end of the working chamber into which the vertically-adjustable electrodes, 4, depend. The top of the hood is closed by a cast-iron plate, 6, which contains a cooling chamber, 7 with a water-inlet pipe, 8, and an outlet pipe, 9. A pipe, 12, for introducing the charge leads through the top of the hood behind the electrodes, and another pipe, 13, for withdrawing the waste gases leads from the hood in front of the electrodes. In operation the electrodes are adjusted to the proper height and the charge is fed in through pipe, 12, until it fills a considerable portion of the hood, and thus seals its lower end. The waste carbon monoxide gases collect in the hood and pass quietly out through pipe, 13, although they are obliged to pass through a considerable body of the charge on their way to the gas-outlet. This somewhat unexpected movement of the gases upward through the charge within the hood instead of out beneath the skirt of the hood is believed to be due to the fact that the gases rising from the zone of reaction at the lower ends of the electrodes tend to work upward through the charge along the electrodes, and that they will thus pass along the electrodes through a path of greater length than through the charge itself. The construction is said to enable the furnace to be operated with great regularity and without filling the surrounding atmosphere with dust from the finely-divided charge, thereby obviating a difficulty which has been experienced with previous constructions.

E. F. Price patents a downwardly-converging vertical stack furnace, with electrodes at the top and bottom. The upper electrode consists of a water-jacketed iron ring at the top of the furnace. The electrode is a body of molten iron which is supported on a cast steel plate containing a chamber for the circulation of water. The development of heat is strongest at the bottom of the charge where it is in contact with the molten iron. The molten iron serves to purify the carbide by withdrawing therefrom the silicon which is one of the normal impurities in carbide, the iron being thereby converted into ferrosilicon.

ELECTROLYTIC PROCESSES.

The container of the Edison nickel-iron battery is made of thin nickel-plated sheet steel. To prevent the nickel coating from peeling off, Mr. Edison first applies by electrolysis a coating of nickel on the steel and then welds the nickel to the steel by heating the plated article in a non-oxidizing atmosphere. In a patent recently granted to Mr. J. W. Aylsworth, an apparatus is described for making this process continuous. The steel is used in form of a long, very thin strip of steel. This strip of steel passes over pulleys automatically through a series of apparatus in which it is cleaned, electroplated, washed and heated in a non-oxidizing atmosphere. The strip is subsequently cut into sections of the required length and form.

For the reduction of lead sulphide to metallic lead, Mr. P. G. Salom has proposed to employ the lead sulphide as cathode with sulphuric acid as electrolyte; the lead is in this case produced by direct cathodic reduction. An essentially different method for the same purpose is described in a recent patent of Messrs. C. E. Baker and A. W. Burwell. They place the lead sulphide in contact with the anode, and employ an electrolyte of molten lead chloride. The result of electrolysis is deposition of lead on the cathode, where it accumulates as a molten layer, while the chlorine set free at the anode decomposes the sulphide, freeing the sulphur and supplying new lead chloride to the electrolyte.

The same inventors have recently patented a method of separating alkali metal from an amalgam, as obtained in a mercury cathode cell. They propose to heat the amalgam in an atmosphere containing hydrogen to such a temperature that distillation of mercury is effected, while the alkali metal unites with hydrogen to form a hydride which remains as a residue. Thereafter the temperature is increased to or above the decomposing point of the hydride to liberate the hydrogen and free the alkali metal.

In copper metallurgy the universal practice is to divide the total treatment into a series of distinct steps, of which all the first ones are purely metallurgical. It is only after the copper is brought up to a certain degree of purity that it is finally refined by electrolysis to practically complete purity. All former attempts to start with anodes of ore, or very impure anodes, have so far been failures. In a patent recently granted to Mr. L. M. Lafontaine, this scheme is again proposed. As electrolyte he uses a copper sulphate solution, containing free acid, with an addition of some lamp-black (1 kilogram per 500 liters); the object of the latter is to improve the regularity and density of the deposit. The main interest appears to be in the construction of the anodes. With copper ores or pyrites as starting material, he places the crushed ore within perforated wooden walls so as to form as compact a mass as possible, while the current enters through a raw copper plate in the center of this mass. In preparing concentrates or dust for anodes, he makes a bath of concentrated quicklime, and when the lime is slaked a certain quantity of concentrate in the proportion of 70 per cent. of concentrate to 30 per cent. of lime is gradually introduced, the mass being stirred as the concentrate is added in order to form a paste or mortar. This paste is then moulded into the desired form.

LETTERS TO THE EDITORS.

Electricity a Phase of Motion.

To the Editors of Electrical World and Engineer:

SIRS:—It is very evident, though this is an age of advanced progression, that, to the average person, the term "electricity" is synonymous with all that is mysterious, while the majority of those who are well informed, or are more or less acquainted with practical electrical application, prefer to speak of it as a subtle agent, distinctly avoiding giving a clear expression to any conception which they may have of what the term really means. This is not to say that no one has brought forward any hypothesis in the nature of a suggested explanation of what the term physically designates. For a few original thinkers have, at various stages of the growth of electrical art, endeavored to outline this physicality. But, in so doing, they have attempted to fit some particular electrical phenomena to the suggested hypothesis, instead of starting at the very foundation, practically speaking, of physical philosophy, and formulating therefrom not an hypothesis but a theory which would fit not only all electrical phenomena but which would also not contradict any physical law which can be accepted, from a practical point of view, as reasonable.

This state of affairs is apparently due to the modern tendency of trying to build a massive superstructure on a poor foundation; that is, the custom of the present time is to slur over the thorough acquisition of fundamentals during the training period by dashing ahead in the effort to obtain, in as short a time as possible and without any but a superficial analysis, the wisdom and thoughts of two or three dozen men between whom and the public considerable potentials exist or have existed—forgetting that each one of these men has traveled, in a laborious and painstaking way, the many circuitous and tedious roads which form an intricate network of communication between the multitudinous points in his own domain.

That a specialist may be more or less successful when he ignores fundamentals is allowed. It must not be forgotten, though, that such success is due to the fact that he has a clear mental grasp of the many details which he combines together by the use of certain hypotheses which suit his own purposes. But the satisfactory acquisition of general knowledge can only be accomplished by a thorough investigation and assimilation in a very broad manner of the few primary laws which apply to anything and everything in the whole universe.

Such primary laws may be briefly summed up as follows:

1. That which is appreciable to the sense-perceptions and is known as matter may be said to exist as matter.
2. That which is appreciable to the sense-perceptions and is known as position of matter may be termed position of matter.
3. Comparative positions of portions of matter may be termed relativity.
4. Portions of matter with their positions normal—or matter in a condition of so-called rest—may be termed a balance or balanced relativity.
5. That which is either directly or indirectly appreciable to the sense-perceptions as an alteration of the normal or balanced relativity of portions of matter may be termed potential or unbalanced relativity.
6. Potential may be either molecular-potential or accumulated-potential; molecular-potential being potential between particle and particle of matter and accumulated-potential being potential between end and end of a mass of matter.
7. Any individual potential, whether molecular or accumulated, constitutes a "Cause."
8. Permission given, either naturally or artificially, to any "Cause" to act produces an "Action."
9. Any individual "Action" produces an "Effect."

Now, a careful perusal of the foregoing nine fundamental laws will enable the student to understand that they apply to all phases of consideration; and that any action, like Tyndal said of heat when he wrote "Heat a mode of motion,' is a case of a phase of motion. This will be more clearly understood when it is remembered that light has been described as vibrations of the ether; which definition, as the ether is only an hypothetical creation of the mind, is a poetical way of explaining that light is a phase of motion. For light is but the transmission from point to point of the relative positions of portions of matter by means of the vibrations of the intervening particles of matter between the two points. Again, sound is even a better illustration of action, being a phase of motion. For such is also the transmission of relativity from point to point by means of the vibrations of the particles forming the intervening matter or conducting medium. And so all known facts appear to point to the theory that electricity, gravitation, magnetism and spirit (life) are only phases of motion—that each individual case of any one of these phases of physics is but the transmission between point and point of the relative positions of portions of matter by means of the vibrations of the particles of the intervening matter or conducting medium.

Apropos of all of which, it may be said—paradoxical as such may seem—that most scientists who have been considered as disagreeing have, truly speaking, agreed. For Huxley's "Persistence of force," Kelvin's "Law of vortices" and the "Conservation of energy," the "Law of cycles," the "Law of ever-recurring reciprocal action," the "Ever-recurring life principle" and the "Law of universal perpetual motion" of others are, correctly speaking, simply different ways of expressing one and the same thing—that the factor that all actions in the universe run in cycles constitutes a case of ever-recurring phases of motion.

It must not be forgotten, too, that, as all so-called phenomena are evidences of motion, all sense-perceptions are simply phases of tactual perception. For visual sense is but a very delicate tactual sense, by which the extremely fine vibrations of matter known as light are received by the relay termed the eye and are then retransmitted by means of the vibrations of the particles of matter constituting the optical nerves to the spiritual ego (brain). That the audal sense (sense of hearing), similarly, is also a tactual sense can be more easily understood. For the tympanum (drum) of the ear is also a relay whereby the vibrations of matter designated as sound are received and retransmitted through the particles of matter comprising the audal conductor to the brain. So, also, does such theory apply to the odoral (smelling) and tastal (tasting) senses. For by means of such the vibratory motions generated by the chemical reactions which take place are felt and transmitted by the vibrations of the particles forming the olfactory and other nerves to the central receiver or brain cells.

May it or may it not be said, therefore, that electricity—like sound, light and heat—being an action is simply a phase of motion whereby change of relative positions of particles or portions of matter are transmitted from point to point; and that everything in the universe, starting from the arbitrary zero of a "Creator," is summed up in the two words, "Matter" and "Position"; that matter at rest is all the portions of the matter in balanced positions; that potential is unbalanced positions of portions of matter; that action is the result of "Permission" given to potential to act; and that any effect is the result of action produced by a potential or the unbalanced positions of portions of matter?

NEW YORK. J. STANLEY RICHMOND.

Insurance on Central Stations.

To the Editors of Electrical World and Engineer:

SIRS.—I would like to get some data in regard to the advisability of carrying insurance on an electric light plant in a town of about 15,000 people. I am interested in a plant worth about $25,000. The construction is of brick, with a fire wall between the boiler room and power house, and with a fireproof ruberoid pitch roof. The building is isolated, the hydrants have 80 pounds pressure, and are in the vicinity of the building. The building is near the railroad, but, of course, has never caught fire. The floor is of wood. The policies do not cover the burning out of the machines themselves, but only in case of a fire in the building itself. We are carrying at present on the plant $22,000 in fire insurance, which covers the building and machinery, and are paying a premium of 2½ per cent. per annum, or $555 a year.

As we have engineers and firemen on hand at all times, and as the only thing that could be burned is the wooden floors and roof underneath the fireproof covering, it seems to me unnecessary to carry any insurance whatever. I have advised with insurance people and they recommend me to continue the insurance, as electrical plants are rather inflammable. I have also considered the advisability of substituting a cement floor for the wood one. The plant is bonded,

and they say that for the protection of bondholders insurance should be carried on all plants. It strikes me, personally, however, as rather a ridiculous proposition to carry a lot of insurance on a practically fireproof building, and if I owned the plant individually I would cut it all out.

I should like to learn very much the general views on this subject and whether your readers know of any fire occurring in plants of this character.

F. W. Danforth.

Buffalo, N. Y.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Unipolar Dynamos.—Hiss.—A communication referring to the recent American Institute paper of Noeggerath. The writer has worked out some designs like those of Noegerrath for electrochemical purposes. One design which was worked through was for a 500-kw machine, turbo-driven, at 1,500 r.p.m., having 12 conductors on the armature, each generating 19 volts with a flux 76×10^6 lines, and of a section sufficient to carry 2,200 amp. These were connected to slip-rings on each side of the cast-steel armature, the output thus being 228 volts and 2,200 amp. By doubling the speed, which would be quite possible with the 30-in. diameter armature employed, the voltage would be doubled, and the output raised to 1,000 kw. The author remarks that difficulties in designing homopolars diminish in proportion to the size. He things there is no reason why motor-generators with homopolars on the direct-current side should not come into use in the near future.—Lond. *Elec. Rev.*, February 17.

A New Material for Brushes.—A note stating that a Swedish firm had placed on the market a new type of dynamo brushes called bronze-carbon brushes. The grains of pure powdered graphite are first plated with a coat of copper and then with a coat of tin, the method not being described. The powder is then formed into brushes by a hydraulic press under very high pressure, without using any binding material. By varying the pressure the hardness of the brushes can be adjusted at will. The brushes are then heated, whereby the tin alloys with the copper and forms bronze, so that each little particle of graphite is now coated with a bronze film. Fig. 1 shows the energy consumption by bronze-carbon brushes

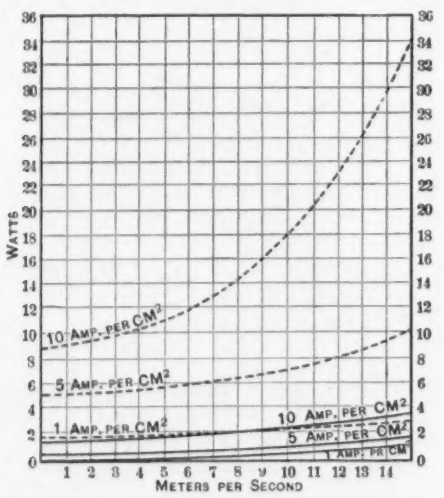


Fig. 1.—Energy consumption by brushes.

(drawn out curves) and good ordinary carbon brushes (dotted curves) for different current densities and different speeds. The abscissæ represent the commutator speed in meters per second, while the ordinates represent watts. For instance, the energy loss at a current density of 10 amp. per sq. cm. at a speed of 15 meters per second is 34 watts with carbon brushes and 3.4 watts with bronze-carbon brushes. The wear and tear of the bronze-carbon brushes is a little greater than that of all-metal brushes, but the wear and tear of the commutator is smaller.—*Elek. Zeit.*, February 16.

Latour Compensated Single-Phase Series Motors.—Bethenod.—The conclusion of his mathematical article. He compares the Latour compensated single-phase series motor with the ordinary single-phase series motor, discusses the operation of the former at constant current strength and deals with the effect of a displacement of the brushes. He then gives an approximate graphical treatment of the subject and finally discusses the revolving field in the Latour compensated series motor. The conclusions of the author are as follows: The compensated series motor has very important properties; first, the possibility of eliminating wattless current at synchronism with the aid of a displacement of the brushes, the power factor being in any case sensibly equal to unity; second, nearly perfect commutation at synchronism on account of the formation of a practically circular revolving field. The author thinks that except for low frequencies, the Latour compensated series motor is superior to the ordinary series motor with respect to power factor, commutation and specific power, although it may perhaps be less flexible. The Latour compensated series motor is also interesting theoretically since it may be considered either as a modification of the ordinary series motor or as a modification of the repulsion motor.—*L'Eclairage Elec.*, February 11, 18.

Induction Motors.—Pichelmayer.—A paper on the calculation of the stray coefficient of induction motors. The author develops a formula which may be considered as a modification of the well-known formula of Behrend in so far as the constant in the latter is replaced by a sum of three terms corresponding to three different stray fields.—*Zeit. f. Elek.* (Vienna), February 10.

Power.

Electric Power from the Waste Gases of Blast Furnaces.—Thomson.—A long and detailed discussion of the commercial possibilities of blast furnace gas for the development of electric power. The first requirement to be fulfilled is that a profitable market for power is near the blast furnace. The author points out at some length the disadvantages which such a plant as a power producer has to overcome. He emphasizes the value of a large number of units to obtain a given output of iron, if the development of a large percentage of the surplus gas into power is to be made possible. Increased cost of construction and operation of a blast furnace plant, made up of a number of small units, as compared with the same items of expense for a plant of the same capacity made up of large units, must be more than balanced by the profits which are to be realized from the operation of the larger power plant. The condition of uninterrupted power supply is of greatest importance and with respect to this requirement, the blast furnace gas power plant is burdened with the responsibility of maintaining operations in spite of trouble which may occur at ore, stone and coal mines, coke ovens, along the lines of transportation, and finally at the blast furnace plant itself. The author then discusses the energy available after all the requirements of the blast furnace plant itself have been met (heating the blast, compressing the blast, auxiliaries). His estimate is very conservative; he even takes Gayley's reduction of fuel by means of dry blast into account. He finds that the amount of surplus heat, available for power per ton of iron produced per hour, is capable of developing 468 hp with gas engines which have a thermal efficiency of 25 per cent. For a blast furnace making 300 tons of iron per day one may rely with certainty of obtaining not less than 6,000 hp. The author discusses at some length the subject of gas cleaning and describes apparatus for this purpose and then gives detailed tables as to the cost of power development under different conditions of operation. For detailed figures reference must be made to the original paper. He concludes that wherever there is a large demand for power, and cheap water power is not available, the blast furnace gas engine power plant need fear no rival. "We are not far from the day when the power house will be as much a part of every modern blast furnace plant as are the condenser and ammonia houses of the modern byproduct coke plant."—*Electrochem. and Met. Ind.*, March.

Efficiency of Hauling Gears.—Hansard.—An illustrated note on the efficiency of some electrically-driven haulage gears in slate quarries. The motors run on a 500-volt, direct-current circuit, and

double reduction gearing with cut steel teeth was specified. The actual reduction of speed is from 600 r.p.m. at the motor shaft to 24.6 r.p.m. at the drum, the ratios being 16 to 83 and 17 to 80. By careful tests the total combined efficiency of the direct-current motor and the gears was found to be 85 per cent. at three-fourths load, while the efficiency of the motors themselves is estimated as 90.5 per cent.—Lond. *Elec.*, February 3.

Superheated Steam.—NEILSON.—The first part of a serial on the superheating of steam and its influence on engine economy. In the present profusely-illustrated installment he describes the various modes of superheating, and typical forms of construction.—*Eng'ing Magazine*, March.

Wood-Working Shops.—An account of some installations of electric driving in wood-working shops, with figures for the amount of power required by various wood-working machine tools under different conditions.—Lond. *Elec.*, February 3.

TRACTION.

Electric Railways.—CORSEPIUS.—A paper read before the Cologne Electrical Society on electric railways in Italy and Switzerland. Concerning the use of storage batteries on the cars, the author appears to hope that some further progress will be made with the introduction of lighter storage batteries. He then gives various details of the installation of the electric railways of Burgdorf-Thun, Lugano, Valtellina. For the latter road recently two new locomotives have been ordered, each with three driving axles and two running axles. The weight of each locomotive is 62 tons, the adhesion weight 42 tons, the normal power 900 hp, the normal speeds 34 and 68 km. per hour (20½ and 41 miles per hour), the normal tractive force 6,000 and 3,500 kg., maximum 9,000 and 7,000 kg. The two different speeds are obtained by changing the number of poles (16 poles and 8 poles). For starting, delta connection with 16 poles is used. The locomotives are to be installed this year. The following data are given concerning the cost of installation. The cost of the Burgdorf-Thun road, which is 40 km. (24 miles) long, was:

High tension line	$28,000
Transformer stations	32,000
Trolley wire and rail return circuits	70,000
Station lighting	4,000
Electric equipment or rolling stock	47,000
Reserve parts	6,000
	$187,000

The cost of the Valtellina road, which is 106 km. (63½ miles) long, was $1,000,000.—*Elek. Zeit.*, February 2.

Valtellina Road.—NOVI AND DONATI.—A paper giving the results of exact measurements made on the Valtellina line where the three-phase traction system is used with 3,000 volts between the two trolley wires. The high-tension motors have a power factor of about 0.9. When connected in cascade the power factor is 0.5 on a level road and 0.75 on steep grades. The total energy consumed by a train during a long time divided by the number of ton-kilometers was in maximum 40 watt-hours; this figure corresponds to the case in which the train consists of a single motor car. If the train is made up of one motor car of 54 tons and four or five trailers of together 60 or 70 tons, the above figure is reduced to 31 watt-hours per ton-kilometer. The smaller consumption of energy with a long train is due to the fact that in this case the air resistance at the front is the same as for a single motor car. The above figures include, of course, the energy consumed during starting, etc., since these figures were calculated from tests of a train over a longer period, including stops. The energy consumed in maintaining a train at constant speed of 60 km. (36 miles) on a level road (but not including the energy for starting or for accelerating) is between 18 watt-hours per ton-kilometer for a locomotive alone and 12.5 to 13.5 watt-hours per ton-kilometer for a train of 130 to 110 tons total weight. The measurements showed that the copper, iron and rheostat losses on a line of 40 km. (24 miles) length with seven starts were about six watt-hours per ton-kilometer, hence less than one-fifth of the average total energy consumption. This shows that there is no justification in trying to reduce the rheostat losses during the starting period in an exaggerated manner, since they are of relatively small importance. Experiments were also made to find how much energy can be returned to the line on a downward grade. If the grade is 0.417 per cent., a train of 110 tons consumes practically no energy; if the grade is steeper, the motors operate as generators. On the line between Chiavenna and Samolaco about 54 per cent. of the potential energy of the train could be transformed into electrical energy and returned into the trolley wires. "The three-phase system has proven completely satisfactory. It has been shown that it is not inferior to the direct-current system with third rail, but that it is rather superior to the latter with respect to efficiency."—*Elek. Zeit.*, February 16; from *L'Elettricita*, November 4.

Single-Phase Road.—An illustrated description of the Stubai Valley road near Innsbruck in Tirol. The electric equipment of each motor car consists of four Winter-Eichberg motors of 40 hp. The four motors are connected in two groups in parallel. The connections of the motors are shown in Fig. 2, where *B* is a lightning ar-

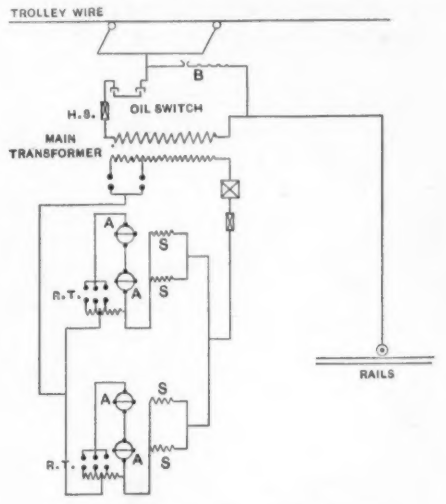


FIG. 2.—MOTOR CONNECTIONS.

rester, *H S* a high-tension fuse. *S* are the stator windings, *A* the armature windings and *R T* the regulating transformers. The consumption of energy measured at the feeding point (so that it includes the losses in the secondary network and in the trolley wire) was found to be 70 watt-hours per ton-kilometer. The mechanical power was calculated on the basis of exact measurements of the train resistance and was found to be 48 watt-hours per ton-kilometer. The total efficiency is, therefore, 68 per cent.—*Elek. Zeit.*, February 16.

Electric Traction on Railroads.—DAWSON.—The first parts of what promises to become a very long serial on the improvements to be expected from the introduction of electric traction on the English railways. While the mileage of British steam railways and the capital invested therein have very greatly increased during the last 30 years, the percentage of net receipts to total paid-up capital has steadily decreased (from 4.41 per cent. in 1870 to 3.4 per cent. in 1903), and the percentage of working expenses to gross receipts has steadily increased (from 48 per cent. in 1870 to 62 per cent. in 1903). The author points out the effect of the competition of electric tramways and begins to discuss what results may be expected from the electrification of the suburban passenger service and of local or branch lines connecting small country towns.—Lond. *Elec. Rev.*, February 3, 10, 17.

Electrification of English Railway.—Some notes on the electric equipment of a section of the Great Western Railway, which runs in connection with the inner circle of the Metropolitan and Metropolitan District Railway Companies. The power will be generated at Park Royal, which is 3½ miles distant from the line. There are to be eight generating sets, each of 750 kw capacity, and consisting of 1,250-hp engines, coupled to 50-periods, three-phase alternators, generating current at 6,000 volts per phase. The engines will be of the triple-expansion, three-crank vertical enclosed type, to work at a steam pressure of 190 pounds, and with steam superheated to 500° F. Current is to be supplied to two sub-stations, where it will be converted to 600-volt direct current by means of motor-generators in parallel with storage batteries. Each train will be made up of two motor cars and four trailers.—Lond. *Elec.*, February 3.

Electric Traction Statistics in Great Britain.—The annual statistical tables of electric tramways and railways in Great Britain. One table gives data on 45 tramways and light railways, which have power houses for traction only, while another table gives data on 108 tramway and light railway systems, which are supplied with current from combined traction and lighting power houses. Fifteen electric railways are in operation and in progress, the largest system being that of the Metropolitan District Railway, the power house

of which has a capacity of 55,000 kw. Twelve electric tramways and light railways are in progress.—Supplement to Lond. *Elec.*, February 3.

London.—An illustrated description of the rotary converter substations of the Metropolitan District Railway and of the automatic methods of signaling used on this road.—Lond. *Elec.*, February 3.

Installations, Systems and Appliances.

Electrolytic Rectifier Versus Motor-Generator.—Boot.—An account of some tests conducted with an electrolytic rectifier for charging the accumulators of a large electric car. The amperes required were 50 and the voltage 118 when the cells were fully charged. The total cost of a motor-generator plant would have been $775, while the cost of a Nodon electrolytic rectifier was only $340. The latter was adopted and proved very satisfactory in practice. The efficiency was found to be about 65 per cent. and does not decrease during use. The rectifier has been in use since October, 1904, and shows no signs of deterioration. There is some evaporation taking place which requires adding distilled water. Two letters with notes on this subject. Isenthal refers to the rush of current on starting which necessarily forms a great disadvantage of electrolytic rectifiers. Wolfe suggests to insert a coil of negligible resistance and high self-induction in series with the direct-current circuit; the object is to smooth out the current curve so that a larger charging current can be used without injuring the cells.—Lond. *Elec. Rev.*, February 10, 17.

Natal.—An illustrated description of electric installations of the Natal Government Railways in South Africa. The new power station in Durban contains three steam-driven generating sets, each of 190 kw capacity, generating direct current at 210 volts for use in the various machine shops. The tool driving is carried out principally by the application of a separate motor to each machine. There is also a motor-generator supplying three-phase current at 2,000 volts, 50 cycles to the Greyvill Depot, where it is transformed down to 200 volts and used for lighting and power.—Lond. *Elec. Rev.*, February 10.

Voltage Rises in Electric Lines and Apparatus.—Three letters of a polemical nature by Benischke, Kalnassy and Seibt on the theory of this subject.—*Elek. Zeit.*, February 9.

Wires, Wiring and Conduits.

Heat Conduction in a Multicore Cable.—Mie.—A mathematical article giving the theory of the propagation of heat, developed in a multicore cable. The author makes several assumptions which simplify the problem; one of these is that the wires are parallel with the cable axis. He gives two formulas of which the second and simpler one is considered to be good enough for all practical purposes. According to this formula, the heat development in a cable with several wires is the same as in a cable with a single wire, the radius of which is $R\sqrt[n]{\frac{nr}{R+(n-1)r}}$. In this formula n is the number of copper wires in the cable, r is the radius of the cross-section of each wire, while the distance between the center of this cross-section and the center of the cable is $R + r$. The significant point in this formula is that it does not contain the external radius of the cable.—*Elek. Zeit.*, February 9.

Earthing.—Lackie.—A paper read before the Glasgow section of the British Institution of Electrical Engineers. The author reviews the present methods of earthing and concludes that the present method of "earthing at any point and direct" is wrong. He makes the following three recommendations: That the metal sheathing on installations for connection to public supply mains should be kept clear of all metal work throughout the entire run of the conductors; that the connection to earth should be through a resistance of such an amount as would allow of not more than, say, two or three times the normal current of the installation flowing to earth in the event of one of the conductors coming in contact with the sheathing, and that the metal sheathing on installations for connections to public supply mains should be joined to earth at one point only.—Lond. *Elec. Rev.*, February 17.

Line Construction.—Matt.—A paper read before the Dresden Electrical Society on different methods used to protect the public against the dangers due to the breaking of a line wire, with a summary of the regulations valid in Germany with respect to such devices.—*Elek. Zeit.*, February 9.

Electrophysics and Magnetism.

Secondary Radiation.—McClelland.—An account of an investigation of the secondary radiation given off by bodies when they are exposed to a strong primary radiation from radium. The author discusses the secondary radiation produced by the more penetrating radium rays only, the β and γ rays. Secondary rays are not produced merely at the surface of the plate struck by primary rays, but come from all parts of a layer of considerable depth. The author analyzes the primary radiation with respect to its power of producing secondary rays and discusses different substances as sources of secondary rays. He speaks of the relative importance of the secondary β rays and the penetrating power of the same and finally discusses magnetic deflection of secondary rays.—*Phil. Mag.*, February.

Changes of Energy During the Magnetization and Electrification of Mediums.—Sahulka.—The energy which is consumed for the magnetization or electrification of a medium comprises two parts, first, the energy represented by the magnetic or electrostatic field produced in the medium, and, second, the energy required for overcoming any molecular friction during changes of the field (hysteresis). When the field disappears, the first kind of energy is regained, although a part of it is lost for overcoming the molecular friction. The losses due to molecular friction are negligibly small only in the case of gaseous mediums. The author discusses at length mathematically the energy of the magnetic and electrostatic field and the change of this energy into mechanical energy. He also gives the results of some tests on the changes of energy during the variation of a magnetic field. Since the paper is mainly mathematical it cannot be briefly abstracted.—*Elek. Zeit.*, February 2.

Emanation.—Kahlbaum and Steffens.—A paper on a spontaneous emanation from metals, producing an effect on the sensitive film of photographic plates without any direct contact.—*Phys. Zeit.*, January 15.

Electrochemistry and Batteries.

Aluminum Rectifier.—Charters.—An account of an experimental investigation in which the author first made measurements on the behavior of different electrolytes when using a direct current. The object was to determine the minimum leakage current at different voltages, since it is known that an alternating current always gives a higher leakage than does a direct current. In the second part of the work a number of efficiency runs were made with a single electrolyte. The main results of the investigation are as follows: Water-cooled aluminum electrodes in a phosphoric acid solution are satisfactory mechanically. A current efficiency of 75-80 per cent. can easily be obtained over a fairly wide range of current. Under the conditions of the tests, the voltage efficiency of the aluminum rectifier may be taken as 30 to 35 per cent. and the energy efficiency as 20 to 30 per cent. With increasing load the power factor rises rapidly to above 90 per cent. The chief cause of the voltage loss is not the internal resistance of the rectifier. The results can be explained by assuming a counter e.m.f. increasing with the current and having a value of 50 to 60 volts over part of the range studied.—*Jour. Phys. Chemistry*, February.

Electrolytic Rectifier.—See the abstract of the article by Boot under "Installations, Systems and Appliances."

Electrolytic Separation of Metals.—Johnson.—A communication referring to two general principles which may be applied to the separation of metals by their selective electrolytic properties. One general principle applying to the separation of a negative metal from a more positive one is by "acid electrolysis." For instance, to separate iron from copper in solution, it is only necessary to have the concentration of the hydrogen as "ionic hydrogen" strong enough so that no iron can be deposited at the cathode under ordinary current densities. A second general principle governing the electrolytic separation of metals is that of selective electrolytic dissolution of a composite metal anode. This is not always complete and can be followed by a cementation process in an outside vat. The latter method has been made use of in several processes. For instance, it has been the practice to run the copper electrolyte over shot copper. The author also uses it in combination with electrolytic refining of iron.—*Electrochem. and Met. Ind.*, March.

The Use of Calcium Carbide as an Explosive in Mining.—Guedras.—A description of a method of utilizing the explosive force of acetylene for mining purposes. A sheet-iron cylinder is used as a cartridge. At its bottom are placed about 50 grains of granulated

calcium carbide, and above this in a separate compartment is a sufficient amount of water to react with the carbide. There is also an air chamber containing an electric fuse. The cartridge is placed in the hole to be exploded, the latter is closed with a wooden plug, and an iron rod attached to cartridge for the purpose of piercing the water compartment is struck, thus liberating the acetylene. After this has been disengaged for about five minutes, the mixture of air and acetylene is exploded. The explosion causes the rocks to fly about much less than would be expected, but they are thoroughly broken up.—*Am. Jour. of Science,* March; from *Comptes Rendus,* Vol. 139, p. 1225.

Electrochemical Reactions in Solid Electrolytes.—HABER AND TOLLOCZKO.—An account of an experimental investigation of the electrolysis of solid barium chloride at about 400° below its melting point; that is to say, about 500° to 600° C. The authors studied especially the validity of Faraday's law, and found that the formation of barium sub-chloride at the cathode took place according to Faraday's law.—*Electrochem. and Met. Ind.,* March.

Relation of Physical Chemistry to Physics and Chemistry.—VAN'T HOFF.—His address delivered before the International Congress of Arts and Science. In the first part he speaks of physical chemistry and our ideas concerning matter, while the second part deals with physical chemistry and our ideas concerning affinity.—*Jour. Phys. Chemistry,* February.

Continuous Versus Intermittent Process.—An editorial discussion of the question whether continuous or intermittent operation is preferable in metallurgical and electrometallurgical processes. As a general rule, for doing the rough work on the ore with the formation of a crude concentrated product and of a waste product containing little metallic value, the continuous process is generally used, while for the finishing or refining treatment the intermittent process is preferable. The reasons of this practice are explained.—*Electrochem. and Met. Ind.,* March.

Progress in Electrochemistry.—KERSHAW.—A summary of the progress made in electrochemistry and electrometallurgy in 1904.—Lond. *Elec. Rev.,* January 20, and February 5.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Utilizing the Light of Geissler Tubes for Taking Photographs of Alternating-Current Waves.—Wilson has found that the negative luminescent light at the cathode of a Geissler tube covers a surface

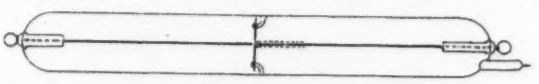
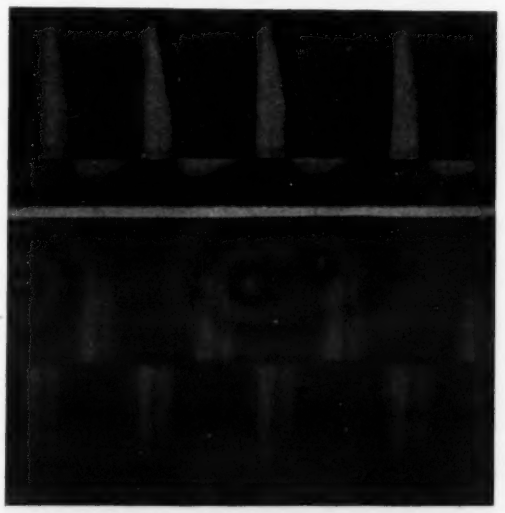


FIG. 3.—GEISSLER TUBE.

proportional to the current as long as the cathode is not yet completely covered with light. With high-tension alternating current both electrodes appear to be covered with a luminescent light; if they are observed in a revolving mirror, the different phases of the



FIGS. 4 AND 5.—ALTERNATING-CURRENT WAVES.

current wave are directly seen, since according to the above law of Wilson more or less of the surface of the cathode is lighted, corresponding to the instantaneous value of the current. It is, therefore, possible directly to photograph the wave form. The tube used by the author is shown in Fig. 3. The two electrodes are in an axial position within the tube, so that one electrode is exactly the continuation of the other electrode. The distance between the two electrode ends is one or two millimeters and the two ends are separated from each other by means of a thin plate of insulating material (glass or mica), which is fastened to the walls of the tube, and which has a somewhat smaller diameter than the tube. The object is to prevent any arcs between the two electrodes. The author reproduces several wave forms determined by this method. Among them is the one shown in Fig. 4, which represents the wave form of a Wehnelt interrupter, while Fig. 5 shows very clearly that if some Lèyden jars are inserted in the secondary of the transformer, which supplies the Geissler tube, oscillations are produced.—*Elek. Zeit.,* February 9.

Sensitiveness of a Galvanometer.—IKLE.—It is usual to give the sensitiveness of a galvanometer by stating (together with the distance from the scale and the resistance) what fraction of an ampere or a coulomb corresponds to a deflection of one millimeter by the needle of the instrument. But in this method the greater the sensitiveness the smaller is the figure in which it is expressed. The author proposes to call this figure the scale value or the constant of the instrument, while the sensitiveness should be defined according to a former proposal of Du Bois, Rubens, Ayrton, Marther and Sumpner, as follows: The sensitiveness for current is the permanent deflection in scale divisions per microampere for a distance from the scale, equal to 1,000 scale divisions, and for a period of 10 seconds. The ballistic sensitiveness is the deflection in scale divisions per microcoulomb for a distance from the scale equal to 1,000 scale divisions and for a period of 10 seconds.—*Phys. Zeit.,* January 15.

Differential Transformer.—TROWBRIDGE.—An article on improvements of the differentially-wound current-detecting instrument of Ho (ELECTRICAL WORLD AND ENGINEER, 1903, Vol. XLI, p. 884) and Duane and Lory for the comparison of inductances and capacities by means of alternating currents. The instrument is a telephone, the bobbin of which is wound in twin in such a way that, when equal and oppositely directed currents are sent through the coils constituting the twin winding, no magnetic field which reaches as far as the diaphragm of the telephone is set up. Secondly, the coefficients of self-induction of the two coils must be equal. To fulfill these requirements it is necessary that the two coefficients of self-induction are equal to each other and either is equal to the coefficient of mutual induction between the two circuits, since in this case no magnetic field whatever would be set up if equal currents were to flow in opposite direction in the two circuits. If, moreover, the ohmic resistances of the circuits are equal, or are made equal by the addition of suitable non-inductive resistance in series with the coils, then when an alternating e.m.f. is applied to the two circuits in parallel the currents are the same in each and the telephone behaves as a perfectly non-inductive resistance and gives out no sound even when carrying relatively strong currents through its coil. The present author has endeavored to improve the construction of the differential telephone. In his instrument all current-carrying lead wires are fixed once for all and the essential part of the apparatus is made larger, and therefore more easy to adjust without at the same time making

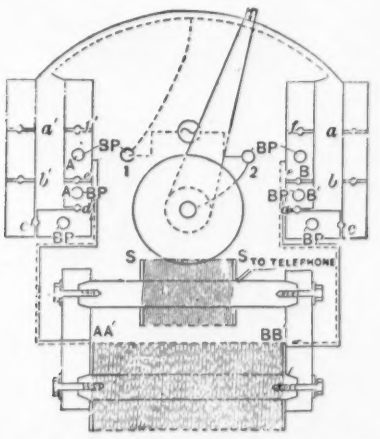


FIG. 6.—DIFFERENTIAL TRANSFORMER.

the instrument too bulky. Fig. 6 shows the connections, including a slide wire and convenient switchboard device for inserting in the circuits the inductances, capacities, or combinations of inductances and capacities to be compared, and one which permits one or both

of the twin coils to be shunted with non-inductive resistance. In Fig. 6 *A B* represents the primary, consisting of the twin coils, *A B* and *A'B'*, which are wound on an iron core, and consist of about 1,000 turns each of No. 24 copper wire; with a little care in winding, their coefficients of self-induction may be brought equal to within one part in 20,000. The secondary, *S*, connects with an ordinary telephone. After setting up the instrument, an alternating e.m.f. is applied to the terminals, 1 and 2, and all the plugs except *d*, *f* and *e'* are removed from the switchboard; this arranges the connections so that the same alternating current flows through the two coils in the opposite direction. If properly wound, no sound should be heard in the telephone even when a current of a couple of amperes is flowing. After testing for equal magnetic effect, plugs *e* and *e'* are removed from the switchboard, all the others being in place, and the slide wire is moved until the telephone is silent. If the instrument is found to satisfy the conditions both of equality of magnetic effect and equality of inductance, it is ready for use in the comparison of inductances, either by the multiple arrangement of connections described by Duane and Lory, or by the series arrangement described by H. Ho.—*Phys. Rev.*, February.

Dynamometer for Testing Line Conductors.—NICOLAUS.—An illustrated paper read before the Berlin Electrical Society and describing an instrument for testing the tension of line wires after they have been drawn. The action of the instrument is based on the fact that when a stretched wire is drawn to the side (not downwards) for a certain distance of always the same length, the force which tends to bring the wire back into its normal position is proportional to the tension. The instrument is described and illustrated.—*Elek. Zeit.*, February 2.

Electricity Meters.—GERHARDI.—Continuations of his serial. The author describes the Ferranti alternating-current meter and the Hookham induction motor meter.—Lond. *Elec.*, February 3. The Scheeffer meter and the Stanley meter are described in Lond. *Elec.*, February 10.

Factory Testing.—WORKMAN.—In a continuation of his illustrated serial on factory testing of electrical machinery, he deals with efficiency and temperature tests of alternators, and describes briefly commercial tests of polarity; iron loss, friction and windage; check on the armature windings and saturation; temperature and insulation. He gives a diagram showing the connections of a special testing set for use for voltages of 15,000 and over. He then passes over to synchronous motors, pointing out some operating characteristics of the same and describing tests to find the relation of field amperes to armature amperes at unit power factor, and temperature tests.—*Elec. Club Jour.*, February.

TELEGRAPHY, TELEPHONY AND SIGNALS.

High-Speed Telegraphy.—Some notes on the development of the Pollok-Virag writing telegraph with which the British post office authorities have made experiments. Some details of recent improvements are described. There is also an editorial note on the subject and it is stated that with this system extremely high speeds are attainable, exceeding those with the Wheatstone automatic system. But it must be borne in mind that the Pollak-Virag system requires a loop line, while the Wheatstone automatic can be worked with an earth return and can be duplexed. Thus, if the speeds are to be compared, the Wheatstone speeds should be multiplied by four. Then, again, a perfectly-balanced telephone line is required for the Pollak-Virag system—one as carefully balanced and in as good condition as would be needed for the so-called duplex telephony or for simultaneous telephony and Hughes working. And further, if this line forms one of a group of telephone lines, as would of necessity be the case, there is danger of inductive disturbances on the latter, should there be the slightest local effect. For instance, for a line from London to Birmingham it is estimated that 500 words per minute could be transmitted by the Pollak-Virag system, while with Wheatstone automatic instruments 300 to 400 words per minute could be transmitted simultaneously each way on each wire, so that nearly three times the output could be got out of the line on the older system. On the other hand, these high speeds of Wheatstone are seldom employed in practice, chiefly on account of the difficulty of handling the strip turned out at so fast a speed. This difficulty is less on the Pollak-Virag system owing to the column printing. But the print in the latter system might not be sufficiently legible for the average public, although "editors, sub-editors and printers" can read it.—Lond. *Elec.*, February 3.

BOOK REVIEW.

STRUCTURAL DESIGNERS' HANDBOOK. By W. F. Scott. New York: The *Engineering News* Publishing Company. 158 pages, 74 illustrations. Price, $2.00.

While a few statements are included in this work relating to the methods of considering loads of various characters upon beams and girders of various shapes and dimensions, the treatment is almost exclusively diagrammatic. For this purpose have been prepared numerous diagrams plotted on section paper of logarithmic dimensions, giving straight lines to represent the loads which can be safely carried. This method is adopted as a means for shortening and possibly eliminating much of the computation and drudgery which are necessary accompaniments of structural designing. The diagrams are confined to commercial materials and designs, and the author has followed the New York Building Code, believing it to be conservative and safe.

Transformer Oil.

In a pamphlet published by the Westinghouse Electric Manufacturing Company, Mr. C. E. Skinner discusses in great detail the subject of oil for transformer insulating purposes, from which we extract the following portion:

The deteriorating effect of moisture on the insulating quality of an oil is very marked. As there are a great many ways in which the oil may take up moisture or moisture may be introduced into the oil, tests for moisture become very important. A very easy and satisfactory method of making test for moisture has been suggested by a prominent oil chemist. This test consists in placing a small amount of oil in a cup, into which is plunged a piece of iron or other metal which is heated to a temperature just below a dull red heat. Any hissing or crackling noise indicates the presence of moisture. Another method of testing for moisture is to place a small amount of anhydrous copper sulphate in a test tube

CURVE OF DIELECTRIC STRENGTH OF OIL.

and then fill the tube with the oil to be tested. After thoroughly shaking, a bluish tinge in the copper sulphate will indicate the presence of moisture in the oil.

It is difficult to determine the exact amount of moisture in oil when the amount is small, and this is usually not necessary, as it is sufficient to know qualitatively whether or not moisture is present. In making test for the effect of different percentages of moisture in the oil it was found necessary to thoroughly dry the oil, then introduce moisture in the form of water in minute quantities in a closed vessel and very thoroughly agitate the oil so as to disseminate the water through it. This method is not considered entirely reliable, but for testing purposes gave results so striking that a curve is given herewith showing some of the results obtained. It is considered that the form of the curve is correct, but it may be that the percentage amount of moisture present between the testing terminals is not entirely accurate. Check tests, however, gave close results. It will be seen from the curve of the accompanying figure that moisture introduced into the oil to the amount of .06 per cent. re-

duced the dielectric strength of the oil to about 50 per cent. of the original value when it was known to be free from moisture, and that there was very little further decrease in the dielectric strength due to increasing the amount of moisture introduced in the form of water.

The viscosity of an oil has been defined as the degree of its fluidity, or its internal friction. The viscosity is not a function of the specific gravity, but in general the less the specific gravity the greater the fluidity of the oil. The viscosity of transformer oil, within limits, is not of great importance, although in general the more fluid the oil the more rapid will be the circulation of the oil in the transformer tank and consequently the greater the cooling effect. The viscosity seems to bear no relation whatever to the insulation tests, the lighter oils—such as kerosene—showing as high, or higher insulation tests than the very heavy oils. The high evaporation and low flashing point of kerosene precludes its use as a transformer oil. Tests for viscosity require special apparatus and special care in testing, and such tests are not usually considered necessary in connection with transformer oil.

Variable Speed and Power Transmission Device.

The accompanying illustrations show a speed-varying device employing extensible pulleys, wherein each portion of the pulley has arms forming part of a conical surface and engaging between similar arms on the opposed portion of the pulley.

Two extensible pulleys are arranged on the separate shafts placed end to end and mounted in a convenient framework. The adjacent ends of the shafts are carried in a movable bearing, this bearing being arranged to slide on the framework and is controlled by a

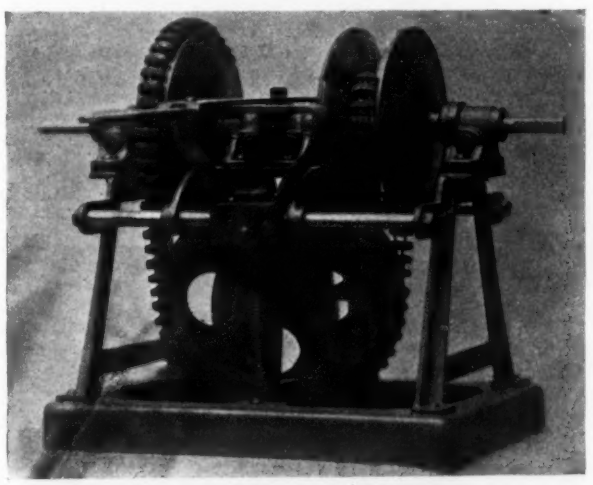


FIG. 1.—VARIABLE-SPEED DEVICE.

lever or other suitable means. Below the central sliding portion suitable guide pulleys are mounted in swiveling supports, the pulleys being adapted to carry an endless rope, belt or chain belt transmitter passing from one of the expanding pulleys to the other of the expanding pulleys. One member or portion of each extensible pul-

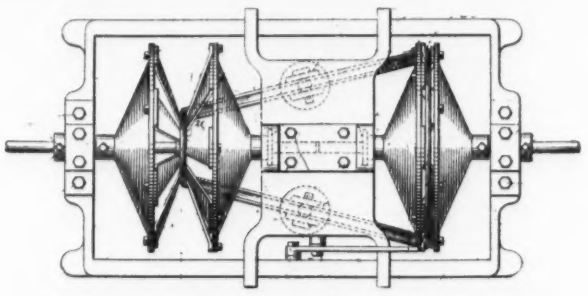


FIG. 2.—PLAN VIEW OF VARIABLE-SPEED DEVICE.

ley is, of course, secured on its shaft, while the other member is free to slide on the shaft during the adjustment. The arrangement is such that when the shafts are revolving a movement of the lever which shifts the central bearing brings together the portions of one pulley while separating those of the other, and simultaneously moves the guide pulleys so that the opposite points of the circumference of the guide pulleys remain in line below the working grooves in the extensible pulleys.

It will thus be seen that by moving the lever in one direction or other, the relative speeds of the two extensible pulleys, and conse-

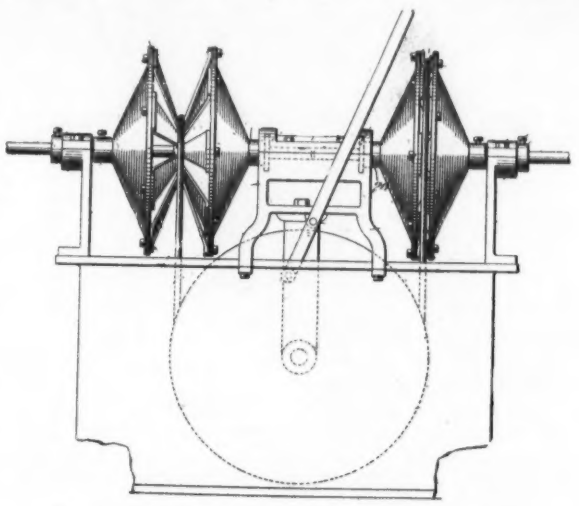


FIG. 3.—ELEVATION OF VARIABLE-SPEED DEVICE.

quently of the shafts on which they are mounted, may be varied at will within wide limits and as gradually or quickly as desired. The end thrust, due to the pressure of the transmitter, is taken up by ball bearings. The tension of the transmitter is regulated automatically to suit the load. This style of apparatus takes up very little space, is claimed to be very efficient, noiseless in operation, and can be built to transmit any amount of power and to give any desired ratio of speed variation. The inventor is C. L. Rosenqvist, Niagara Falls, N. Y.

Micanite Canopy Insulator.

As a means of eliminating the danger from fires due to defective insulation in electric light pictures at the point where the wires project through the floor or wall and make connection with the wires of the electroliers, the Mica Insulator Company, of 218 Water Street, New York, has placed upon the market the "Young" canopy insulator shown in Figs. 1 and 2. The insulator is made of the well-known material "micanite," built up from large laminations of mica

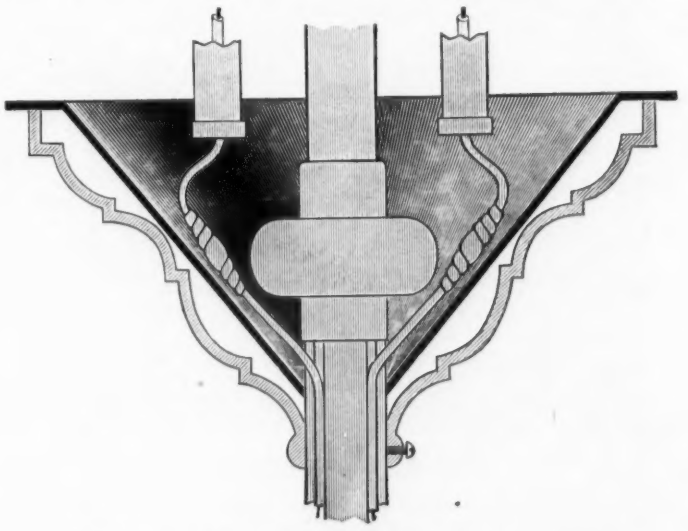


FIG. 1.—MICANITE INSULATOR IN PLACE IN FIXTURE.

and moulded with both flange and taper into one solid whole. As seen from Fig. 1, the flange gives perfect protection to the brass canopy from the surface of the ceiling or wall, thereby removing any possibility of a short-circuit between the two conducting wires,

between either of the conducting wires and the canopy, or between the wires through the canopy to the ceiling. The insulator is claimed

FIG. 2.—MICANITE CANOPY INSULATOR.

o be absolutely fire-proof and has been approved by the National Board of Fire Underwriters.

Mechanical Transport of Air.

In a recent paper on the mechanical transport of air, Mr. W. B. Snow, of the B. F. Sturtevant Company, says the simplest method of such conveyance is by the process of flowing from a pressure difference between the two ends of a vertical conduit, of which the chimney is an illustration. Such a difference of pressure is created by heating the air within the chimney, thereby reducing its density and inducing at the bottom an inflow of the cold and heavier outside air. Because of its simplicity it was but natural that this method should have preceded the application of mechanical devices for the production of artificial ventilation. The fan or centrifugal blower has, however, long been accepted as the only effective mechanism for creating wholesale air movement.

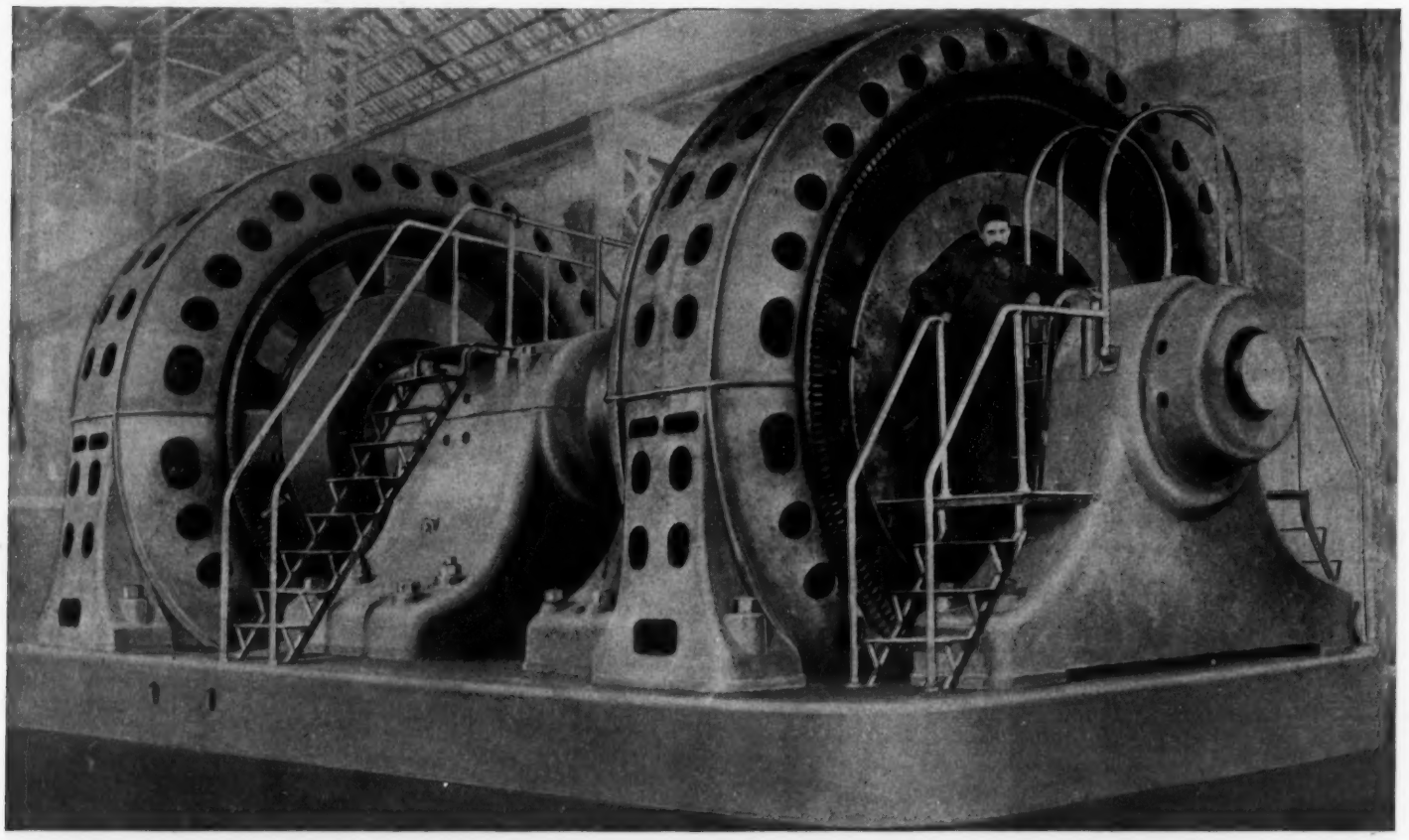
The air compressor, the blowing engine and the positive or rotary blower are not primarily designed for mere movement of air, but more essentially for the creation of pressure and transmission of the same through the medium of the air. The propeller or disc fan on the other hand is efficient only under very low resistances and is incapable of economically forcing the air through conduits of very great length.

Much thought has been expended upon fan design with many resulting arrangements of the fan blades and casings. In all forms the effort has ever been to improve the efficiency; but frequently greater volume or pressure has been secured only by increased expenditure of power. In fact, the simpler still remains not far behind the more elaborate in economy of operation.

The effect of high velocities is clearly shown by the fan in which doubling the rotative speed simply doubles the volume discharged, while producing four times the pressure and requiring eight times the power. That is to say, the volume varies directly as the number of revolutions; the pressure varies as the square and the power required as the cube of the revolutions. It is, therefore, evident that a fan which is half large enough to move the desired volume at the required pressure will have to run at double the speed and will absorb eight times the power necessary to operate a fan of proper proportions. In a word, a fan should be so proportioned to its work as to make possible the delivery of the necessary quantity without exceeding the minimum permissible pressure.

The Largest Motor in the World.

The largest electric motor ever built is now being installed at the plant of the Shawinigan Water & Power Company, Shawinigan Falls, Que. This machine was recently constructed by the Allis-Chalmers Company at its electrical works in Cincinnati, and embodies in its design the characteristics of the Bullock alternators, which have proven so successful in their application. It is a synchronous motor of 8,000 hp. The rating of the generator operated by this motor, on standard specifications, is 5,750 kw at 300 r.p.m.



LARGE ELECTRIC MOTOR, SHAWINIGAN WATER & POWER COMPANY'S PLANT AT SHAWINIGAN FALLS.

The combined machines, in addition to their enormous capacity, are remarkable for concentrating in an exceedingly small floor space a capacity of 12,000 kw.

The photograph of the machines, reproduced herewith, was taken while they were being tested at the shops, by the Behrend system, under full load conditions corresponding to 7,200 kw on the generator, with the expenditure of no more than 300 kw in order to produce the same losses in the machine which exist under full load conditions.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade reports are somewhat conflicting, but on the whole improvement has followed more settled weather, and the outlook is regarded as favorable. Mercantile collections are not as prompt at the East as elsewhere, but the liabilities of commercial failures in February were much smaller than a year ago. The number of failures during the month was 857, as compared with 847 in February last year, but the liabilities showed a very large decrease, being $8,931,690, against $15,813,964 in the corresponding month in 1904. The number of failures during the week ending March 2, as reported by *Bradstreet's*, numbered 206, against 220 the week previous, and 195 the corresponding week last year. Traffic blockades have been lifted and railway earnings in February were only 5.1 per cent smaller than last year, despite the severe weather early in the month. Little idle machinery is noticed in the iron and steel industry; textile mills are increasingly active, and New England shoe shops are shipping more freely than a year ago, although there is still delay in booking orders for fall footwear. Minor manufacturing plants are also preparing for large sales, indicating that confidence remains unshaken. Iron and steel still hold the lead in the industries, both as regards demand and strength of prices, finished products of the latter responding to insistent demand in a higher range of values in many lines. It is stated that leaders in the iron industry are growing rather uneasy over the accelerated pace which the markets are developing, and the indications of an unwelcome boom are multiplying. The tonnage produced and taken is of unprecedented volume, and yet in many branches makers are falling behind in deliveries, the only exceptions being steel rails and bridge material. The bridge shops have been running light during the past few months, but are beginning to do better. Chicago, Kansas City and St. Louis report active spring distribution, and trade is looking brighter in the lake region, where an unprecedented volume of iron ore shipments is foreshadowed. Southern trade is bettr. Hardware is brisker, and purchasing of railroad equipment is on a liberal scale. In the metal market tin, and lead are lower, but copper is firm at unchanged quotations. The principal producers still quote Lake at 15¼ to 15⅜c.; electrolytic, 15⅛ to 15¼c.; casting stock, 14⅞ to 15c.

THE BALL & WOOD COMPANY, steam engine builders of Elizabeth, N. J., is adding a new department to its business, that of flange welding and pipe bending. The increasing use of high pressure and superheated steam has developed the need of pipe joints, which are absolutely reliable; and in the process the company is bringing out, the use of forged steel flanges welded to the pipe will eliminate two weak spots out of three in every steam joint, the pipe and flange being made homogeneous. Contracts havve been let for a new smith's shop at the Ball & Wood works for the purpose of doing this work, and it is expected to be in full operation shortly. Mr. O. M. Jones has resigned his position in the New York sales office of the National Tube Company, and become the manager of the new department, and expects to fill the requirements of contractors and engineers although it is not the intention of the company to enter the contracting field. For informaion regarding this work letters should be addressed to The Ball & Wood Company, Welding Department, 17 Battery Place, New York.

POWER PLANT ENGINES ORDERED.—The South Shore Electric Company has ordered from Allis-Chalmers Company, of Milwaukee, one heavy duty 24 x 48 engine for direct connection to a 425-kw alternating current generator, to be installed in its power plant at Hammond, Ind., whose capacity is proving inadequate to take care of the heavy demands now made upon it. The People's Power Company, of Moline, Ill., owing to an important extension to its business, has found it necessary to make some additions to its plant, and Allis-Chalmers Company has been awarded the contract for one horizontal compound Reynolds Corliss engine, 24 x 50 x 48, for direct connection to a generator. This engine will be practically a duplicate of one previously made by the same company, which has been giving excellent satisfaction. An interesting novelty in its construction is the fact that the cylinders have valves in their heads.

THE NEW YORK, WESTCHESTER & BOSTON RAILWAY COMPANY has established a branch office in the building of the Mt. Vernon Trust Company, at Mt. Vernon, N. Y. This will be the headquarters of Mr. E. B. Naylor, the resident engineer in charge of the work between the city line and White Plains. Mr. Naylor's staff is composed as follows: Assistant engineer, H. L. Collier; transit man, R. P. McClave; level man, M. Wormser; transit rodman, Henry Robinson; level rodman, O. F. Palmer; chainmen, H. C. Winchester, Jr., and D. A. Seeley; axeman, Arthur Webb. This force of engineers has already begun the laying out of the exact route between the northern boundary of the city of New York and White Plains. Three corps of engineers are working in the Borough of the Bronx, and plans are being pushed with a view to breaking ground just as soon as a general thaw sets in.

MORE EQUIPMENT, ETC., FOR NEW ORLEANS.—In view of the rapid growth of business and the exceptionally heavy load resulting therefrom at the power plants of the New Orleans Railways Company, it has been decided that purchases of additional equipment be made soon. The main generating station, for which 7,000 hp. of Babcock & Wilcox boilers and three Curtis turbines, of 1,500 kw. capacity each, have been contracted for some time ago, is to have two further boiler units of 1,000 hp. each. Two motor-generator sets, 2,300 volts to 275 volts, will also be ordered, with switchboard, etc. A number of arc lamps and regulators, poles, etc., for lighting the streets of the city, have also been requisitioned for. Contracts for underground and overhead cables and conductors are also about to be placed. Sanderson & Porter, Kuhn-Loeb Building, William Street, New York, will let the contracts.

WESTINGHOUSE APPARATUS FOR COPPER MINES.—The Mammoth Copper Mining Company, of Salt Lake City, has just placed an order with the Westinghouse Electric & Manufacturing Company for a large addition to its electrical equipment. A total of nearly 800 horse-power in induction motors of different sizes, together with a motor-generator set, transformers, switchboard and three mining locomotives, is included in the order. The motors, two of which have a rated capacity of 200 horse-power each, and five of 50 horse-power each, will operate on three-phase, 2,000 volt circuits. Electrical machinery is used very extensively in mining operations, and this order is merely indicative of the progress being made in this field.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, has received an order from the Northern Electrical Manufacturing Company, of Madison, Wis., for 135 of the new type of Cutler-Hammer machine tool controllers, equipped with fuses and switch in conformity to the United States Navy specifications. All of these controllers will be installed in the plant of the Winchester Repeating Arms Company. Although this controller has been on the market but a few months, its sales have far exceeded the most sanguine expectations.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., has increased its capital stock to $100,000. It is the intention of the company to build a new four-story brick factory during the coming year. Its present quarters have become too small for its largely increasing business. It is also the intention of the company to make a specialty of the panel and switchboard business. Its new No. 5 catalogue is now ready for delivery and the company will take pleasure in sending it upon request.

MORE EQUIPMENT FOR ROCKLAND COMPANY.—The Rockland Light & Power Company is about to contract, through Sanderson & Porter, its consulting engineers, for additional equipment to go in the main power plant at Nyack, N. Y. The present installation includes a 400-kw. Stanley belted type alternating current generator, and a Westinghouse turbo-generator of similar capacity. Plans are now being prepared for about a 50 per cent. increase in the capacity of the station.

TROLLEY CONTRACT FOR WATERBURY.—The New England Engineering Company has secured the contract for the electrical work for a trolley line from Jeanette to West Newton, Pa., which is to be built by the Jeanette, West Newton & Monongahela Valley Street, Railway Company. The road will be about thirteen miles long. The construction work will begin about April 1. Approximately $325,000 is involved in the contract.

EQUIPMENT FOR COLUMBIA UNIVERSITY.—The lighting plant in Columbia University is to be re-designed. The work is in the hands of Mr. C. O. Mailloux. Two 200-kw. and one 100-kw, 240-volt, direct-current generators will be put down. The existing plant is a 125-volt one. It will be changed to 240 volts.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY has just closed contracts for switchboards for the following places: Columbus, O.; Grinnell, Ia., and Tonopah, Nev.

ELECTRIC MINING EQUIPMENT FOR JAPAN.—A large consignment of electrical apparatus for the mining of copper is about to be shipped from this country for the Furukawa Western Bureau in Japan. This consignment will consist of two Westinghouse 200-kw. 500-575-volt direct-current, horizontally-split, engine-type generators, direct connected to Westinghouse vertical, compound, single-acting steam engines, size 18 and 30 by 16 in., capable of developing 305 ihp. under a steam pressure of 110 lbs., and a 26-in. vacuum. A marble switchboard for controlling a third generator, which has been ordered in addition to the above two, will contain three generator panels and two feeder panels complete with standard arrangement of instruments. The condenser outfit will consist of one Knowles air pump and jet condenser, of horizontal pattern, capable of condensing 19,200 lbs. of steam per hour, or the exhaust from all three of the engines which will form the final equipment. The consignment will include two Knowles horizontal, triplex, portable, single-acting mining pumps, each mounted on an iron truck and connected through a double reduction gear with a ratio of 4 to 1 to Westinghouse 20-hp., 500-volt direct-current motors. Each of the above pumps is to have a capacity of 20 cu. ft. of water per minute, against a head of 300 ft. The pumping equipment will include two 140-hp., 500-volt, shunt-wound, direct-current motors, to be directly geared to two Riedler pumps, and two more Knowles mining pumps, driven by 20-hp. Westinghouse motors, exact duplicates of the ones described above, have recently been ordered. The orders for all of the above equipments have been placed through Takata & Co., engineers and contractors of Tokio, Japan.

SOME CROCKER-WHEELER MOTOR ORDERS.—The Crocker-Wheeler Company, through its New York offices, Mr. F. B. De Gress, manager, reports recent receipt of a number of motor orders. Jacques Kahn, glass mirror manufacturer, has ordered for installation in his West Thirty-seventh Street plant, fifteen motors, 230-volt, slow-speed type, ranging in capacity from 1 hp. to 20 hp. Current will be derived from a De Laval turbine. The Consolidated Safety Pin Co.'s factory, Bloomfield, N. J., for which Mr. Walter Kidde, White Building, is the engineer, is to have several Crocker-Wheeler, 240-volt slow-speed motors, varying in capacity from 3 hp. to 10 hp. The stereotype department of the *New York World* is to be equipped with about a dozen motors of from ½ hp. to 10 hp., 230-volt, standard speed build.

5,000 KW FOR PAPER MILLS.—The St. Croix Paper Company proposes to construct mills at Sprague's Falls, on the St. Croix River, near Calais, Me., in which electricity will play a very important part. There will be two power plants, one hydraulic of about 5,000 hp and a steam equipment of 2,000 hp. The generating equipment for the first named will consist of machines aggregating 3,500 kw, arranged for direct connection to the water turbines. The steam plant will comprise a 1,500-kw generator, direct-connected to a 2,500-hp steam engine. There will be no less than 3,000 hp of motors. The general contract for the plants has been awarded to Mr. Frank B. Gilbreth, of 34 West Twenty-sixth Street. The consulting engineer is Mr. George F. Hardy, 309 Broadway, New York City.

WATERTOWN ENGINE ORDERS.—The Quintard Iron Works have just closed a contract for the installation of two 60-kw. generators and one 30-kw. generator; the engines are to be Watertown cross compound. The specifications were drawn by Messrs. Bates & Neilson. The New England Dressed Meat & Wood Company has placed an order with the Waterton Engine Company for vertical cross compound engines of 125 hp. for direct connection to pumping machinery. The Watertown Engine Company has received an order for engines for the lighting plant of the Springfield Provision Company at Somerville, Mass.

EQUIPMENT FOR VARICK BUILDING.—Contracts have been allotted by Sanderson & Porter for a good portion of the electrical plant to go in the Varick Realty Company building. The engines have been contracted for with the Hooven, Owens, Rentschler Company. There will be three Hamilton Corliss tandem compound machines of 225 hp. capacity, each arranged for direct connection to generators. The Allis-Chalmers Company secured the generator order, which consists of three 150-kw. Bullock machines. The boiler contract, which calls for three units of 300-hp. each, went to the Washington Company, Taylor Building.

THE NORTHERN ENGINEERING WORKS, of Detroit, Mich., has been awarded a contract for the electric traveling cranes required in the new plant of the Detroit Steel Casting Company. There will be one 30-ton, 4-motor crane, and two 10-ton, 3-motor cranes, all 70 ft. span. It has also secured a contract for one 3-motor, 5-ton special electric traveling crane from the Michigan Malleable Iron Company.

EQUIPMENT FOR B. H. R. R. BUILDING.—The office building to be constructed at Clinton and Remsen Streets, Brooklyn, by the Brooklyn Heights Railroad Company, will be equipped with several motors, switchboard and electric wiring by Johnston Livingston Junior Company, 113 East Twenty-second Street, New York City. Pattison Brothers, Flatiron Building, are the consulting engineers.

EQUIPMENT FOR D., L. & W.—The Delaware, Lackawanna & Western Railroad Company, 26 Exchange Place, New York City, of which Mr. L. J. Bush is the chief engineer, is to instal separate power plants for handling coal at Newark, N. J. A 100-hp. engine arranged for direct connection to a 65-kw. generator and several motors are about to be ordered. A somewhat similar outfit is to be used for a like purpose at Syracuse, N. Y.

LOWEST BIDDER FOR SCHOOL EQUIPMENT.—Mr. William M. Sheehan, 136 Liberty Street, is the lowest bidder for the contract for equipment to go in the DeWitt Clinton High School, on 10th Avenue. His figures are $37,658. Mr. Sheehan has also submitted the lowest tender, $6,737, for the equipment to be installed in Public School, No. 83, 100th Street and Third Avenue.

EQUIPMENT FOR INDIANA STONE PLANT.—The Indiana Silicate Stone Company, of which concern Mr. W. W. Ife, 15 Wall Street, is engineer and one of the directors, is to build a plant at Evansville, Ind., which will have a 200-kw generator arranged for direct connection to a 300-hp each. Several motors will also be purchased.

CONTRACT FOR PEARLINE PLANT.—The general contract for the Edgewater, N. J., plant to be operated by James Pyle & Sons (Pearline), New York City, has been undertaken by the V. J. Hedden & Sons Company. The engineers are Lockwood Green & Co., of 93 Federal Street, Boston. A good-sized electrical plant will be installed.

CONTRACT FOR WASHINGTON BUILDING.—The general contract, which includes the electrical equipment, for the new Washington (D. C.) *Times* building has been let to the Geo. A. Fuller Company, Home Life Building, Washington. McKim, Mead & White, of 160 Fifth Avenue, New York City, are the architects.

EQUIPMENT FOR LOFT BUILDING.—Pattison Brothers, Flatiron Building, have been appointed electrical engineers for the equipment in the large loft building to be built at 126-128 Fifth Avenue by the Fifth Avenue and Eighteenth Street Realty Company. Mr. Henry Corn, 1170 Broadway, is president.

BELL TELEPHONE OUTPUT.—The net output of the American Telephone & Telegraph Company for January was 92,934 instruments, an increase of 39,144 over the same month last year. There were 4,573,408 instruments outstanding at the end of January, as against 3,833,397 at the same date last year.

MOTORS FOR NEW JERSEY RUG FACTORY.—Several motors are about to be purchased for installation in a new factory at Freehold, N. J., to be operated by A. & H. Karaghensian, Oriental rug dealers, of 225 Fourth Avenue. Mr. T. J. Breslin, same address, has the matter in hand.

PLANT FOR BIG HOTEL.—Considerable electrical equipment is to be put down in a new apartment hotel, "The Langham," which is to be constructed in Central Park West, between Seventy-third and Seventy-fourth Streets. Clinton & Russell, 32 Nassau Street, are to be the architects.

PLANT FOR BROOKLYN APARTMENT.—An isolated plant is to be installed in a big apartment house to be built by Mr. Max Ginsburg, 87 World Building, at Pierrepont and Henry Streets, Brooklyn. Mr. Frank S. Lowe, of 186 Remsen Street, Brooklyn, is the architect.

EQUIPMENT FOR ROCHESTER, N. Y.—The Hooven-Owens-Renschler Company, of Hamilton, Ohio, has secured a contract for a Hamilton Corliss engine, to be direct connected to a 300-kw. generator of General Electric build, in a Rochester, N. Y., power plant.

MOTORS FOR STEEL PLANT.—A large addition is to be built to the Sharon (Pa.) plant of the American Steel Foundries Company, 74 Broadway. Mr. D. P. Mendenhall is the company's engineer. A large number of motors of various sizes will be installed.

PLANT FOR NEW BANK BUILDING.—The new Chemical National Bank building to be constructed at 270 Broadway is to have an isolated lighting plant. The architects will be Trowbridge & Livingston, of 424 Fifth Avenue.

PLANT FOR ORPHAN ASYLUM.—The Colored Orphan Asylum to be built at West 143d Street, near Broadway, is to have an isolated power and lighting plant. The architects are Robertson & Potter, of 160 Fifth Avenue.

EQUIPMENT FOR BROOKLYN PACKING HOUSE.—An electrically operated packing house is to be constructed at 49 West Morgan Avenue, Brooklyn, by Mr. Adolph Goebel. Mr. Theobald Engelhardt is the architect.

Financial Intelligence.

THE WEEK IN WALL STREET.—At the close of the week stock prices were irregular after having recovered from a sharp bear attack early in the week. United States Steel securities made new high prices on buying induced by favorable steel trade conditions. The firmer appearance of the money market had some slight effect upon the prices, and the bond market continues firm. Electric securities were quite featureless, and call for no special comment. Allis-Chalmers, both issues, are down ⅜ of a point on the common and 2½ on the preferred, the closing quotations being 17⅜ and 63½, respectively. General Electric closed at 188, a point higher, and Westinghouse, common and preferred, both made net advances, the closing quotations being 181 and 192. Electric Storage Battery closed at 87⅝, being a net advance of ⅜ point. Western Union advanced ⅜ net, closing at 93¾, and American Telephone & Telegraph lost 1¼ points, closing at 145¾. The tractions all made net gains that in Brooklyn Rapid Transit amounting to 3⅛, Metropolitan Street Railway, 1⅞, and Interborough Rapid Transit (on the curb), 2, the closing quotations being 66½, 123⅜ and 206, respectively. Following are the closing quotations of March 6:

NEW YORK

	Feb. 28	Mar. 7		Feb. 28	Mar. 7
Allis-Chalmers Co.	17¼	17¼	Electric Vehicle pfd.	22	21
Allis-Chalmers Co. pfd.	63	63½	General Electric.	186¼	187½
American Tel. & Cable.	93	92	Hudson River Tel.	..	..
American Tel. & Tel.	144	145	Interborough Rap. Tran.	203½	206
American Dist. Tel.	33	32	Metropolitan St. Ry.	120⅝	123⅝
Brooklyn Rapid Transit.	64⅜	66⅜	N. Y. & N. J Tel.	..	172
Commercial Cable.	..	..	Marconi Tel.	..	..
Electric Boat	40	39	Western Union Tel.	93⅛	93⅜
Electric Boat pfd.	79	79	Westinghouse com	181	180
Electric Lead Reduction	¼	¼	Westinghouse pfd	187¼	190
Electric Vehicle	14	12			

BOSTON

	Feb. 28	Mar. 7		Feb. 28	Mar. 7
American Tel. & Tel.	144½	146	Western Tel. & Tel. pfd.	*102	102
Cumberland Telephone.	120	120	Mexican Telephone.	1⅛	1⅛
Edison Elec. Illum.	251	250	New England Telephone.	136	137
General Electric.	187	187	Mass. Elec. Ry..	14	16¼
Western Tel. & Tel.	*21	20	Mass. Elec Ry. pfd.	57	62

PHILADELPHIA

	Feb. 28	Mar. 7		Feb. 28	Mar. 7
American Railways.	52⅛	52¼	Phila. Traction.	101	99¾
Elec. Storage Battery.	88	87	Phila. Electric.	10⅝	10¼
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	31	29¾
Elec. Co. of America.	11⅜	12⅛			

CHICAGO

	Feb. 28	Mar. 7		Feb. 28	Mar. 7
Central Union Tel.	..	..	National Carbon pfd.	113	113
Chicago Edison.	170	..	Metropolitan Elev. com.	20½	22
Chicago City Ry.	..	..	Union Traction.	..	11
Chicago Tel. Co.	142	142	Union Traction pfd.	..	..
National Carbon.	43	44			

* Asked.

LIGHTING CONSOLIDATION AT BALTIMORE.—A special meeting of the stockholders of the United Electric Light & Power Company was held on February 14 to act on the consolidation of the Wenstrom Electric Company, of Baltimore City, with the United Electric Light & Power Company. As already announced, the new company formed by the merger of the Wenstrom Company with the United Electric Light & Power Company takes over a majority of the stock of the Consolidated Gas Company, which was purchased by Mr. S. Davies Warfield, acting in behalf of the Consolidated Company, from Messrs. Bertron, Storrs & Griscom, of New York, who had previously acquired it from a syndicate of Baltimore bankers. The name of the company formed in the consolidation is the Consolidated Gas, Electric Light & Power Company. The capitalization of the company is as follows: $700,000 6 per cent. prior lien cumulative stock; $6,000,000 5 per cent. cumulative preferred stock; $6,000,000 common stock. The mortgage of the Consolidated Gas, Electric Light & Power Company to the Continental Trust Company, trustee, which was placed on record recently, provides for an authorized issue of $15,000,000 4½ per cent. thirty-year gold bonds, $8,639,000 of which will be reserved in the treasury for the future requirements of the company. In the consolidation the United Electric Light & Power Company and the Wenstrom Electric Company, of Baltimore City, go out of existence, the Consolidated Gas, Electric Light & Power Company succeeding to all the properties and assets of those companies. The mortgage securing the new issue of bonds is a first lien on 58,220 shares of stock of the Consolidated Gas Company, being more than a majority of the stock of that company; 8,050 shares of stock of the Mount Washington Electric Light & Power Company, being substantially all of the stock of that company, and a lien on all the properties of the old electric light companies subject only to the outstanding bonds. The $700,000 of 6 per cent. prior lien cumulative stock is issued to retire the $700,000 5 per cent. preferred stock of the United Electric Light & Power Company. The $300,000 preferred stock in the treasury is cancelled. The prior lien stock is preferred, both as to dividends and to capital—that is to say, it is a lien on the assets of the company ahead of the preferred and common stocks and stands next to its mortgage bonds. Holders of the old 5 per cent. preferred stock can either exchange their stock for the 6 per cent. prior lien stock or take par ($50) cash and accrued dividends to the date of consolidation. The following gentlemen were elected directors of the company: S. Davies Warfield, Alexander Brown, T. J. Hayward, Wm. A. Marburg, Charles Adler, F. S. Landstreet, Alton S. Miller, Charles T. Crane, A. N. Brady, J. B. Dennis, T. F. Ryan and S. R. Bertron. The new board organized by electing the following officers: S. Davies Warfield, chairman of the board; Alton S. Miller, vice-president; Douglass Burnett, manager; W. S. Symington, secretary-treasurer; P. O. Keilholtz, engineer. Mr. Miller, who was elected vice-president of the company, has been, and is now, general manager of the Consolidated Gas Company. He has been active in the management of the gas company, and has contributed largely to the success of that company. Mr. Douglass Burnett, who was elected manager in charge of the electrical department, has been manager of the United Electric Light & Power Company. Mr. W. Stuart Symington, elected secretary and treasurer, was secretary and treasurer of the United Electric Light & Power Company. Mr. P. O. Keilholtz, who was elected engineer in charge of the electrical department, occupied a similar position with the United.

NATIONAL CARBON.—The National Carbon Company has issued its report for the year ended January 31, 1905, as follows:

	1905.	1904.	1903.	1902.
Net earnings	$846,307	$736,441	$594,371	$586,812
Preferred dividends	315,000	315,000	315,000	315,000
Balance	$531,307	$421,441	$279,371	$271,812
Charged off for depreciation, etc.	383,336	280,429	256,637	217,745
Surplus	$147,971	$141,012	$22,734	54,067
Common dividends	82,500	.....	.....	.....
Surplus	$65,471	$141,012	$22,734	$54,067

The general balance sheet as of January 31, 1905, compares as follows:

Assets:	1905.	1904.	1903.	1902.
Real est., mach., plants, etc.	$9,177,611	$9,025,000	$9,270,000	$9,200,000
Mdse., mfg. and unmfg.	622,763	618,227	448,216	418,540
Cash	295,249	320,713	162,462	235,473
Cash res. for betrm., etc.	15,500	.....	.....	65,266
Cash res. for pf. dividend	78,750	78,750	78,750	78,750
Bills and accts. receivable	389,616	429,189	364,601	354,842
Total	$10,579,488	$10,471,879	$10,324,029	$10,352,870
Liabilities:				
Pfd. stock	$4,500,000	$4,500,000	$4,500,000	$4,500,000
Com. stock	5,500,000	5,500,000	5,500,000	5,500,000
Pfd. div.	78,750	78,750	78,750	78,750
Accts. payable	134,905	93,570	89,278	141,485
Pft. and loss sur.	365,833	299,559	156,001	132,635
Total	$10,579,488	$10,471,879	$10,324,029	$10,352,870

The annual report of the National Carbon Company for the fiscal year ending January 31, 1905, shows a balance over preferred dividends of $531,307, equivalent to 9.6 per cent. on the $5,000,000 common stock. This compares with 7.6 per cent. shown for the common in the fiscal year 1903-4. The company paid during the year an initial dividend of 1½ per cent. on the common, the full 7 per cent. on the $4,500,000 preferred stock having been paid every year since organization. The working capital shows as follows:

January 1:	1905.	1904.	1903.	1902.
Current assets	$1,323,128	$1,368,139	$975,278	$719,280
Current liabilities	134,905	93,570	89,278	141,485
Working capital	1,188,223	1,274,569	886,000	577,795

The increase in working capital since January 31, 1902, has been $610,423, or over 100 per cent. The falling off in working capital last year was due to unusually heavy charging off. The amount charged off in 1904-5 was $383,336 compared with $280,429 charged off in 1903-4.

UNION SWITCH & SIGNAL.—The Union Switch & Signal Company has issued the following for the year, ended December 31:

	1904	1903.	1902.	1901.
Gross	$2,486,840	$2,132,835	$1,774,005	$1,605,649
Interest and other deductions	2,127,999	1,803,513	1,420,322	1,308,143
Net	$358,841	$329,322	$353,683	$297,506
Preferred dividends	169,656	130,867	79,726	79,726
Surplus	$189,185	$198,455	$273,957	$217,780

NORTHWESTERN TELEPHONE.—Following a meeting of directors of the Northwestern Telephone Company in Minneapolis, the announcement has been made of an appropriation of $1,000,000 to be expended for improvements and country extensions. Of this sum, $600,000 will be expended in Minneapolis, St. Paul and through Minnesota, the remainder in North and South Dakota.

BUYING OF CHICAGO EDISON.—President Samuel Insull, of the Chicago Edison Company, has authorized the statement, according to Chicago advices, that recent buying of the stock in the market has been for local investment account, and not for an Eastern syndicate seeking control, as reported.

UNITED RAILWAYS OF ST. LOUIS.—It is stated that the North American Company has finally secured a controlling interest in the United Railways of St. Louis. Details of the deal are withheld.

GENERAL ELECTRIC.—The intention to declare an extra dividend is denied.

General News of the Week

The Telephone.

TUCSON, ARIZ.—The Consolidated Telephone Company, of Arizona, has perfected negotiations leading toward the acquisition of all independent telephone lines in the Territory. The new system is to become a part of the new American Telegraph & Telephone Company.

HEALDSBURG, CAL.—Articles of incorporation of the Healdsburg & Alexander Valley Telephone Company have been filed. The company has a capital stock of $5000. Following are the directors and officers: C. F. Matthews, president; W. F. Young, secretary; Thomas Alexander, William McCutcheon and C. C. Hall.

DENVER, COL.—The Elk Mountain Mutual Telephone Company has been incorporated the capital being $37,500. The principal office will be at Steamboat Springs. The company is formed by farmers of Routt, Larimer, Rio Blanco, Eagle and Grand counties. The directors for the first year are James B. Male, F. S. Follet, William W. Adair, W. M. Hitchins, W. D. Dunfield, Charles Blackburn and Patrick Cullen.

PETERSBURG, ILL.—The Petersburg Telephone Company has been granted a franchise by the City Council.

CARTHAGE, ILL.—The Mississippi Telephone Company has increased its capital from $25,000 to $50,000.

GOLCONDA, ILL.—The Pope County Telephone Company has increased its capital stock from $5000 to $15,000.

PANA, ILL.—The Pana & Christian County Telephone Company has increased its capital stock from $15,000 to $30,000.

AVON, ILL.—The Union Telephone Company, of Fulton County, Ill., capital $2500, has been formed. Incorporated by Lucien Gray, John W. Barlow and others.

SHELBYVILLE, ILL.—The South Tower Hill Mutual Telephone Company has filed articles of incorporation. The incorporators are John W. Jones, Siveer S. Hertens and others. Capital $450.

ALBION, ILL.—The Edwards County Mutual Telephone Company has been organized to operate a telephone system. The company has been incorporated by Phillip King, William H. Reid, T. B. Mitchell.

BELLEVILLE, ILL.—The Kinloch Telephone Company has obtained the contract for the police telephone system in Belleville for $500 a year. The Bell Company has had a contract since 1896 at $525 a year. New boxes and instruments will be installed.

ANDERSON, IND.—The stockholders of the Delaware & Madison County Telephone Company have elected directors and the board organized with A. L. Johnson, Muncie, president; J. J. Netterville, Anderson, vice-president; Thomas Bromley, Muncie, secretary and general manager. The company reported 4243 telephones in operation in Muncie, Anderson, Elwood and Alexandria.

WEBB, IA.—The Webb Telephone Company seeks a franchise for a local exchange.

SCRANTON, IA.—The Scranton Independent Mutual Telephone Company has been formed by R. Lower and others. Capital stock $5000.

BRONSON, IA.—A new telephone company has been organized at Bronson and officers have been elected as follows: M. G. Smith, president; A. T. Elliott, treasurer; F. H. Oertel, secretary.

PORTSMOUTH, IA.—Plans are on foot for the consolidation of all independent telephone lines of Portsmouth, Panama and Persia under one management. The plan includes a stock company.

BURLINGTON, IA.—The Mississippi Valley Telephone Company will expend $200,000 in rebuilding lines and new equipment for exchanges at Burlington, Keokuk, Fort Madison, Wapello and Muscatine.

DAVENPORT, IA.—The Iowa Telephone Company is installing a new six-position switchboard at the exchange here. This additional board is made necessary by the increase in the number of long-distance subscribers.

ARGYLE, IA.—The Vincennes & Wayland Telephone Company has reorganized into a stock company. The new officers are L. W. Sargent, president; John Hays, vice-president; Fred Newberry, secretary; West W. Newberry, treasurer.

VINTON, IA.—The Farmers' Mutual Telephone Company, of Vinton, has ordered a new switchboard to accommodate 250 new patrons. The exchange connects with 2250 farmers in Benton County, and is growing. The officers are: J. B. F. Bunton, president; R. S. Harper, vice-president; J. M. Beatty, secretary; John Lorrenz, treasurer; G. Urice, general manager.

JEFFERSONTOWN, KY.—The new Home Rural Telephone Company has been organized by thirty citizens of this place. Capital $270.

LOUISVILLE, KY.—The Mohawk Valley Independent Telephone Company has been organized by the farmers residing between Fredericksburg and Palmyra. The officers elected are as follows: President, Jonathan Boston; Secretary, A. L. Rudolph; treasurer, Clint Fouts.

NEW ORLEANS, LA.—The Cumberland Telephone & Telegraph Company has been directed by the Railroad Commission of Louisiana to reduce several of its rates in this city.

NEW ORLEANS, LA.—The Southern Pacific Railroad Company will install a telephone service along its lines, an arrangement with that purpose in view having been made with the Cumberland Telephone & Telegraph Company.

BETHEL, ME.—The Central Intervale Telephone Company has been incorporated with a capital of $1000. The officers are: President, O. A. Buch; treasurer, C. C. Bryant.

AUGUSTA, ME.—The Lorimer Automatic Telephone Company has been incorporated, capital $10,000,000. President, G. R. Hadlock, Augusta; treasurer, E. F. Whittum, Augusta.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company, of Ann Arbor, has been formed, capital $300,000.

ADRIAN, MICH.—The Morenci Telephone Company, which has filed articles with the Secretary of State, has increased its capital from $10,000 to $20,000.

MT. CLEMENS, MICH.—After a conference between a committee of the Business Men's Association and General Manager Land of the Michigan State Telephone Company, at which no compromise could be secured on the high rates, the citizens decided to establish an independent exchange and secured about $3000 worth of stock.

GARY, MINN.—An extension of the Gary telephone line to Ada is projected.

ROYALTON, MINN.—The Royalton-Morrill Telephone Company will extend its lines to Foley in the spring.

MAPLE LAKE, MINN.—A stock company is to be formed to establish a local telephone exchange. A. W. Nary is interested.

BALATON, MINN.—The Balaton Mutual Telephone Company has dissolved, selling out its right, title and interest to N. G. Noodgate, of Slayton.

ST. PAUL, MINN.—The Hector Telephone Exchange Company, of Renville County, has filed articles of incorporation with the Secretary of State. Capital stock $25,000.

BLUE EARTH, MINN.—The Southern Minnesota Telephone & Telegraph Company has been incorporated at Winnebago City. A. W. Colvin is president and W. A. Streete, secretary.

MINNEAPOLIS, MINN.—The Farmers' Mutual Telephone Company, of Nobles County, has been incorporated; capital stock, $20,000. Frank Baker is president; R. J. Jones, treasurer.

WILLMAR, MINN.—The Minnesota Central Telephone Company, with headquarters at Willmar, shows an increase of earnings the past year of over $17,000. Nearly $53,000 was spent in betterments, and $29,800 was paid in dividends.

HATTIESBURG, MISS.—The City Council of Hattiesburg and the Retail Merchants' Protective Association have opened a vigorous and determined campaign against the Cumberland Telephone Company to compel the corporation to reduce its rates and improve the service or surrender its franchise in this city.

GLENDIVE, MONT.—Ed. S. Baer, H. J. Haskell and others have been granted a franchise for a telephone line.

ST. LOUIS, MO.—Charles H. Turner, it is stated, has sold out his holdings in the Kinloch Long-Distance Telephone Company. At the annual meeting of the stockholders of that corporation February 20, Mr. Turner's place on the Board of Directors was filled by the election of William J. Lemp, Jr. The other directors were re-elected as follows: C. Marquard Forster, William F. Nolker, Breckenridge Jones, August Gehner, Adolphus Busch, Julius S. Walsh, William T. Orthwein, Sam. M. Kennard, Henry Nicolaus, James Green, Rolla Wells and Philip Stock.

FIRTH, NEB.—A telephone company has been organized at Firth. J. M. Van Berg is president and M. H. Wittstruck, secretary.

FREMONT, NEB.—Bell & Beaver, of this city, stockholders in the Independent Telephone Company, became owners of a large part of the stock of the Fremont Telephone Company.

HUMBOLDT, NEB.—At the annual meeting of the stockholders of the Dawson-Nemaha Telephone Company officers were elected as follows: President, Joseph G. Heim; vice-president, J. G. McGinnis; treasurer, Jonas Heim; secretary, N. B. Judd.

TRENTON, N. J.—Papers merging the Delaware & Atlantic Telegraph & Telephone Company, the Trenton Telephone Company, the South Jersey Telegraph Company, the Hopewell Telephone & Construction Company and the Bay Shore Telephone Company have been filed, and a charter of incorporation granted to the consolidated company. The name of the new concern is the Delaware & Atlantic Telephone Company, and it is capitalized at $400,000, all common stock. The officers and directors are: President, Union N. Bethell, Upper Montclair, N. J., secretary and treasurer, Winfield S. Fiersall, Germantown, Pa., and James E. Mitchell, Theodore Spencer, William T. Westbrook and H. S. Huidekoper, all of Philadelphia.

WORCESTER, N. Y.—The Worcester Telephone Company has been incorporated with a capital stock of $1000. The incorporators are Jas. Nelson, Guy Coats and S. Shafer, Worcester.

ALBANY, N. Y.—The directors of the Hudson River Telephone Company have elected the following officers: Chairman, Charles F. Cutler; president, U. N. Bethell; vice-president, James H. Manning; treasurer, James J. Fitzsimmons, and secretary, Walter B. Butler.

GRANVILLE, N. D.—A franchise has been granted for a telephone system to O. G. Nordmarken, J. O. Weaver and others.

ADENA, OHIO.—The Adena Exchange Company has certified to an increase of capital stock from $5000 to $20,000.

RICHWOOD, OHIO.—The Richwood Telephone Company has increased its capital stock from $20,000 to $50,000. O. P. Lenox is the president.

WAPAKONETA, OHIO.—The New Knoxville Telephone Company will be incorporated with a capital of $10,000. The incorporators are George W. Holl, F. H. Fledderjohann and others.

PERRYSBURG, OHIO.—The directors of the Maumee Valley Telephone Company have elected officers as follows: President, Jacob Davis; vice-president, G. F. Hoffman; treasurer, R. R. Hartshorn; secretary, R. R. Hillard.

JEFFERSON, OHIO.—The Dorset Telephone Company has been incorporated with a capital stock of $3000. There are already a few miles of line. A total line of 30 to 40 miles will be built to Jefferson, Leon and Pierpont.

KIEL, OKLA.—The Dober & Kiel Rural Telephone Company, of Kiel, has been formed with a capital stock of $5000. The incorporators are B. E. Watson, W. R. Barney and others.

BAKER CITY, ORE.—The Farmers' Mutual Telephone Company of this city has been chartered by George Ebell, Leo Stewart and others, capital $2000.

MALLEAY, ORE.—Citizens of Malleay will install a telephone system in this town. John Craig is president; W. L. Simerl, vice-president; T. J. Ramsden, secretary, and Judge Waldo, treasurer of the organization.

PHILADELPHIA, PA.—At the regular annual meeting of the stockholders of the Bell Telephone Company it was shown that the company is now in full control of the Delaware & Atlantic Telephone Company, which heretofore has been leased by the Bell Company, although a consolidation has not been effected. The annual report, which is the first complete one published, shows a marked increase in the Company's earnings and subscribers over 1903. The net increase in subscribers during 1904 was over 15,000. The total earnings for the year were $3,756,059.79, with expenses $2,810,803, dividends declared $836,010, and net earnings $945,256.79, leaving a surplus balance of $109,246.79. The entire Board of Directors was re-elected, with Charles F. Cutler, of New York, as chairman.

NEWPORT, R. I.—Plans for the Providence Telephone Company now under consideration provide for an expenditure of about $50,000 in the city of Newport. The remodeled exchange will have a maximum capacity of 2000 lines, an increase of 1000.

EUREKA, S. D.—The Edmund County Mutual Telephone Company will extend its rural lines.

DELL RAPIDS, S. D.—The Dell Rapids Telephone Company will extend its system during the present year.

ELK POINT, S. D.—The Jefferson & Civil Bend Telephone Company has been incorporated with a capital of $5000. President, James Cates; secretary, Peter Bernard.

MEMPHIS, TENN.—The Alabama Independent Telephone Company has been organized with a capital of $500,000.

HASKEN, TEX.—The Hasken Telephone Company, capital $10,000, has been incorporated by G. R. Couch, J. F. Posey and others.

GRANBURY, TEX.—The Fort Worth Long Distance Telephone Company, of Granbury, has been formed with a capital of $30,000. The incorporators are D. C. Cogdell, R. W. Bowden and others.

PROVO, UTAH.—The Rocky Mountain Bell Telephone Company will greatly improve its local system at an expenditure of about $30,000.

BRATTLEBORO, VT.—The Brattleboro telephone exchange has decided to place its wires in the village underground early next summer.

LYNCHBURG, VA.—At a special meeting of the Common Council the bid of $100 of the Southern Bell Telephone & Telegraph Company for the telephone franchise, recently adopted by the two branches of the Council, was unanimously accepted.

SEATTLE, WASH.—The Sunset Telephone Company will establish two branch offices in this city within two or three months and between $250,000 and $300,000 will be expended on extensions in the territory bordering Seattle.

SPOKANE, WASH.—R. H. Porter and E. W. Porter, of Juliaetta, Ida., have organized the Potlatch Telephone Company which will connect Juliaetta, Kendrick, Southwick, Leland and the country between by telephone. The company will operate under contract with the Pacific States Telephone & Telegraph Company and has taken over the exchanges at Juliaetta and Kendrick.

MONITOR, W. VA.—The Farmers' Union Telephone Company has been formed, capital $10,000.

UPLAND, W. VA.—The Frazier's Bottom, Upland & Glenwood Telephone Company has been incorporated, capital stock $5200.

SUPERIOR, WIS.—The People' Telephone Company will erect a new building and extend its system at a cost of $35,000.

LAFAYETTE, WIS.—The Wilcox Valley Telephone Company, of Lafayette, capital $2500, has been incorporated by Albert E. Harris, Charles J. Fox and others.

BELOIT, WIS.—The Beloit Farm Telephone Company has been formed, capital $5000. Incorporators: A. T. Saberson, Charles F. Lathers and B. C. Hansen.

GAYS MILLS, WIS.—The Utica Farmers' Mutual Telephone Company has been formed by Edward Johnson, George B. Mitchell and others. The capital is $1500.

WAUSAU, WIS.—The Wausau Telephone Company has voted to increase its capital stock from $10,000 to $20,000. This money to be used in making changes in the system.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company has been formed with a capital of $500,000. Incorporated by A. L. Hutchinson, Edward Fairfield and others.

APPLETON, WIS.—The West Appleton Telephone Company has been formed with a capital of $10,000. President, A. Millett, Searsmont, Me.; treasurer and clerk, C. R. Bartlett, Appleton, Wis.

Electric Light and Power.

LITTLE ROCK, ARK.—This city will install a 350-hp boiler and a 350-hp engine at the electric light plant. John W. Bleidt is superintendent.

CEDARVILLE, CAL.—H. Hawkins is interested in the construction of an electric light plant.

SAN FRANCISCO, CAL.—Another Nevada power project is contemplated by T. L. Oddie, and California capitalists are at the head. It is proposed to construct a plant near Mono Lake.

SAN FRANCISCO, CAL.—The Eel River Power & Irrigation Company, has been incorporated with a capital of $500,000. Directors: F. D. Madison, San Rafael; H. B. Muir, Willits; R. E. Donohue, Ukiah, and others. The headquarters will be at San Francisco.

SAN FRANCISCO, CAL.—The municipality of Healdsburg, Cal., has put in operation its new steam auxiliary station to supplement a water-power electric lighting plant. The new station is equipped with a Bullock 3-phase, 150-kw generator driven by an engine supplied by the Tracy Engineering Company.

SILVERTON, COL.—It is proposed to install at the municipal electric light plant a 110-kw unit and a new switchboard, and remodel the lines for a 3-phase system. H. S. Sherman is manager.

WINSTED, CONN.—There is a movement on foot here to establish a municipal electric light plant.

WALLINGFORD, CONN.—It is proposed to develop water power of about 200-kw for day service at the municipal electric light plant. A. L. Pierce is manager.

STAFFORD SPRINGS, CONN.—Arrangements have been made for the continued operation of the Stafford Springs Electric Light & Gas Company and the announced intention to close down the plant was cancelled. Mr. Warner, of Bridgeport, was appointed receiver of the company, and he was authorized to continue the operation of the plant. A reorganization of the company will probably be effected, and the plant, which is now in a somewhat dilapidated condition, will be improved.

VALDOSTA, GA.—The Mayor and Council are investigating the cost of an electric light plant.

WASHINGTON, GA.—It is proposed to install at the municipal electric light plant a 150-kw alternating-current generator. Thos. Ludlow is superintendent.

HAILEY, IDA.—The present owners of the Hailey Electric Supply Company propose building another plant at once.

WALLACE, IDA.—The Wallace Light & Water Company will probably install some new machinery this summer; also a steam plant. D. C. McKissick is superintendent.

KIRKWOOD, ILL.—The Kirkwood Electric Company will extend its lighting service to two neighboring towns.

MORTON, ILL.—Beyer Bros., owners of the electric light plant, propose to increase their power circuit to 150-kw and put in one 200-hp engine.

DECATUR, ILL.—A new gas and electric light company has been formed here by W. L. Shellabarger, Jas. J. Finn and others, with a capital of $50,000. The company will apply at once for a franchise.

ROCK ISLAND, ILL.—The Taylorville Gas Company and the Taylorville Electric Light Company have been consolidated under the name of the Taylorville Gas & Electric Company. The capital stock is $127,000.

EAST ST. LOUIS, ILL.—Mayor Cook has appointed C. B. Goedde, Jacob Gohn and L. Smith a committee to visit other cities to ascertain the cost of electric lighting and of municipal ownership of electric plants. W. J. Crocken is city engineer.

DECATUR, ILL.—The Consumers' Gas & Electric Company has been recently organized. The company has been incorporated with a capital of $50,000 by Wilson M. Bering, Charles S. Needham and James M. Gray.

MORRIS, ILL.—The Fields Electric Light Company (F. B. Handwerk, manager) has in contemplation the following improvements: 5 miles of line; a 250-hp compound engine; a 200-kw alternator; one condenser; a pump; day power circuit and all night service.

RIDGEVILLE, IND.—The Ridgeville Electric Light, Heat, Power & Water Company has been incorporated. Jos. Lay is president.

BICKNELL, IND.—The Bicknell Light & Power Company has been incorporated with $10,000 capital stock, by August L. Brocksmith, Beverly P. Barnes and Jas. G. Welton.

MUNCIE, IND.—H. F. Warren, superintendent of the city electric light plant writes that it is proposed to construct a new central lighting plant at once. Gas or oil engines and storage batteries will be used. The plant will cost $120,000.

ODON, IND.—The Odon Light & Power Company proposes to construct a new power house with new engine, boilers and dynamos; also water works.

CRESTON, IA.—J. C. Sullivan is interested in the construction of an electric light plant.

CENTERVILLE, IA.—Richard Slattery has petitioned for a franchise for an electric light plant.

CORNING, IA.—C. K. Munns, owner of the Corning Electric Company, expects to overhaul the entire outside plant the coming spring.

NORTHWOOD, IA.—The Northwood Electric Light plant contemplates installing an engine, two generators and switchboard apparatus.

WATERLOO, IA.—At a meeting of the Waterloo & Cedar Falls Gas & Electric Company it was voted to expend $100,000 in equipping the electric light plant with new engines and dynamos and installing a gas plant at Cedar Falls.

DECORAH, IA.—The Decorah Electric Light Company will probably develop a water power and transmission plant here and one at Waukon, requiring in all 18 miles of line. Two 200 to 250-hp wheels, two 128-kw, 6600 volt, 3-phase, 60 cycle generators, about 250-kw in transformers and the usual items for such an equipment will be required. W. H. Burtis is president.

JEWELL, KAN.—A. G. Blackenship is interested in the construction of an electric light plant.

LAWRENCEBURG, KY.—The Lawrenceburg Electric Light Company organized by electing the following officers: President, J. M. Johnson; vice-president, E. W. Ripy; secretary, Dr. C. A. Leathers; treasurer, R. S. Collins.

GRETNA, LA.—The Algiers Water Works & Electric Light Company proposes to extend the system to Gretna and furnish that place with light. It is also proposed to construct 10 miles of 3-phase electric railway between Algiers and Gretna.

LAKE CHARLES, LA.—S. O. Shattuck, city clerk, writes in regard to the construction of a municipal electric light plant for Lake Charles, that Ruebel, Schwettman & Wells, of St. Louis, Mo., have completed the plans and specifications, the plant to cost about $70,000. The matter is now in the hands of the city attorney.

BAR HARBOR, ME.—It is stated that New York and Boston capitalists have purchased the stock of the Bar Harbor & Union River Water Power Company and will construct a dam on Union River near Ellsworth.

CHICOPEE, MASS.—The Dwight Manufacturing Company, of Chicopee, is about to install an electric power plant in its big mill to supplement the present power equipment of water wheels and steam engines. Westinghouse apparatus will be used.

LEICESTER, MASS.—A deal is under way by several business men of the town for the purchase of the business of the Rawson Light & Power Company. A five-year contract between the Rawson Light & Power Company and the town for street lights expires July 1.

HOPKINS STATION, MICH.—W. F. Nicoli, of Hopkins Station, is interested in the construction of an electric light plant.

ALPENA, MICH.—Bids will be received by R. J. Crable, City Recorder, on March 23, for the construction of water works and an electric light plant.

BAY CITY, MICH.—The City Council has granted to the City of West Bay City a franchise to do commercial electric lighting in Bay City.

SHELBY, MICH.—It is proposed to install at the municipal electric plant, new engines, an alternating-current generator and meter system. H. L. Andrus is superintendent.

SAULT STE. MARIE, MICH.—The Edison Sault Electric Company will construct a plant this year which will have over 2000-hp to start with. About $120,000 will be expended this summer. Alex. Dow, of Detroit, is interested. The plans for the plant have been prepared by Prof. Gardner S. Williams.

GRACEVILLE, MINN.—It is proposed tb install a direct-current generator in the municipal electric light plant in the spring. P. F. Daly is superintendent.

KEYSTONE, MINN.—The Keystone Lumber, Power & Development Company has been organized for the purpose of utilizing water power and furnishing electric light to Keystone. C. J. Patton, of Keystone, is interested.

WIGGINS, MISS.—The Wiggins Electric Light Company has been formed with a capital stock of $10,000.

GREENVILLE, MISS.—The Greenville Light & Power Company contemplates the complete re-equipment of its station.

LAMAR, MO.—The Lamar Light & Water Company proposes to install an engine, boiler and alternator in the spring.

SEDALIA, MO.—The Sedalia Water & Light Company proposes to combine its three electric plants in one and construct a new central station.

ST. LOUIS, MO.—Bids will be received at the quartermaster's office, St. Louis, Mo., until March 17, for an electric lighting system for the Jefferson Barracks, Mo.

JEFFERSON CITY, MO.—The Jefferson City Light, Heat & Power Company will add to its present service a power plant, motor service and lighting service for arc and incandescents.

ALMA, NEB.—The citizens have voted to issue bonds for water works and an electric light plant.

WARRENSBURGH, N. Y.—The Warrensburgh Electric Light Works proposes to install a new turbine.

SYRACUSE, N. Y.—The Syracuse Lighting Company, it is stated, has purchased the electric lighting interests in Fayetteville.

COHOES, N. Y.—The Hudson River Electric Company has petitioned the City Council for a franchise for an electric light system here.

MIDDLETOWN, N. Y.—The Orange County Lighting Company contemplates installing some new machinery. W. J. Max is superintendent.

PITTSFORD, N. Y.—The Pittsford Light & Heat Company, of Pittsford, has been incorporated by Samuel Hutchinson, John Steve and B. N. Wiltsie, of Pittsford.

EAST CREEK, N. Y.—The East Creek Electric Light & Power Company has in contemplation another water power plant 3½ miles further up the same stream. Mr. J. D. Cairns, St. Johnsville, is manager.

NIAGARA FALLS, N. Y.—The Niagara Falls Electrical Transmission Company has been formed with a capital of $100,000 by Harry Highland and Frank A. Dudley, of Niagara Falls; Frederick Nichols, of Toronto, Ont.

CANASTOTA, N. Y.—The electric light committee has submitted its report on the construction of a municipal electric light plant. It estimates the cost of a plant with a capacity of 50 arc lights and 6000 incandescent lights at from $30,000 to $35,000.

NEW YORK, N. Y.—John T. Oakley, Commissioner of Water Supply, Gas and Electricity, of New York City, will receive bids March 15 for lighting the streets, etc., in all the boroughs of New York City, for a term of 9 months and 16 days, from March 16 to Dec. 31, 1905.

MONROE, N. H.—The Monroe Water Power Company, which proposes constructing dams across Connecticut River and furnishing electricity in New Hampshire and Vermont has been incorporated. A. S. Batchellor, of Littleton, N. H., Chas. H. Hosford, of Monroe, and Geo. Van Dyke, of Boston, Mass., are among the incorporators.

URBANA, OHIO.—The City Council has granted C. H. Marvin and T. A. Edmondson a franchise for an electric light and hot water heating plant.

MASSILLON, OHIO.—It is proposed to bond the city for $500,000 to be used for the construction of water works, an electric light plant and city hall.

SEBRING, OHIO.—The Sebring electric light plant has passed into the hands of Pittsburg parties, and will be greatly improved, enlarged and additional machinery installed.

MARION, OHIO.—The Columbus, Delaware & Marion Railway Co., owners of the electric light plant, proposes installing new power house equipment and will rebuild the pole line and change the arc system.

DALLAS, ORE.—The Dallas Electric Light Company proposes installing a 200-hp engine, a 125-hp boiler and extend the line.

LANSDALE, PA.—The citizens have voted to issue $25,000 for improving the electric light plant and other work.

WERNERSVILLE, PA.—Bids will be received April 1 for the construction of an electric light plant, to cost $3500. G. W. Wertz is interested.

PHILADELPHIA, PA.—Bids will be received March 7 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yard, League Island,, a quantity of wire, conduit and fittings, electrical supplies, etc. H. T. B. Harris, Paymaster General, U. S. N., Washington, D. C.

UNIONTOWN, PA.—The agreement of merger and consolidation whereby 11 electric light companies are consolidated, forming the Western Pennsylvania Electric Company has been recorded. The capital is $337,500. The officers are William S. Kuhn, president; Jacob Van Wagener, vice-president; Jesse H. Purdy, secretary, and John F. Cockburn, treasurer, all of Pittsburg.

LEAD, S. D.—The Belt Light & Power Company will install three 500-kw units, with boilers, etc., 20 miles of new power lines, 1000 horse-power in motors, etc.

DICKSON, TENN.—Wm. McDonough is interested in the construction of an electric light plant.

MEMPHIS, TENN.—The Council has granted the Merchants' Light & Power Company a 30-year franchise.

JEFFERSON CITY, TENN.—The Jefferson City Electric Light Company will erect a new plant. A new dynamo has been purchased.

KNOXVILLE, TENN.—It is stated that the Knoxville Power Company will probably commence during the coming spring the construction of its power plant.

BROWNSVILLE, TENN.—The Burt-Smith Company, owners of the electric light plant, will install during the years a 150-kw dynamo and make other improvements.

SALT LAKE CITY, UTAH.—Mr. Samuel Newhouse has made application to the City Council for a franchise for an electric lighting plant in this city.

WINCHESTER, VA.—Dr. H. H. McGuire is chairman of the committee which has under consideration the question of constructing an electric light plant at a cost of $25,000.

COLONIAL BEACH, VA.—Warren S. P. Combs, president of the Colonial Beach Electric Light & Power Company, writes that it is proposed to construct an electric light plant, ice plant, telephone system and steam laundry at a cost of $25,000.

SNOHOMISH, WASH.—The Snohomish Electric Light & Water Power Company contemplates installing a 300-hp engine and making some line extensions.

KAUKAUNA, WIS.—The Kaukauna Electric Light Company contemplates adding to its water wheel capacity and installing a direct-current power circuit of 100-hp.

GRAND FALLS, N. B.—A project to develop the water power of Grand Falls has been laid before the government of the province. The capitalists interested are those comprising the Electric Manganese Company, and include B. E. Kingman, of New York, and Fred. Sayles, of Providence, R. I. The project includes the manufacture of ferro-manganese at the falls and the operation of big pulp, paper and saw mills, the operation of international railway by electricity and the transmission of electric power between St. John River valley to be sold for use in lighting and manufacturing along the line as far as the city of St. John. It is estimated that the project will involve an expenditure of from $3,000,000 to $4,000,000.

FENELON FALLS, ONT.—The Board of Water, Light and Power Commissioners proposes installing an arc light plant of 50-lights capacity.

OWEN SOUND, ONT.—It is stated that bids are wanted March 17 for $10,000 electric light improvements bonds. A. J. Spencer is town treasurer.

KINGSTON, ONT.—The lighting committee will recommend to the City Council of Kingston, that the electric light rates be reduced from 14c. to 12c. per kw-hour on and after July next.

BRACEBRIDGE, ONT.—This city contemplates duplicating its present machinery equipment at the municipal electric light plant, at an early date. Alex. C. Salman is secretary and treasurer of the Council.

The Electric Railway.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will spend $200,000 in improvements to its power plant, which will include the purchase of mechanical stokers, coal conveyors and coal bins, one 3000-kw turbine generator, etc.

JACKSONVILLE, FLA.—Application has been made for the appointment of a receiver for the North Jacksonville Street Railway & Town Improvement Company. This is the only street railway company in the United States that is owned and operated by negroes. Cooper & Cooper, of Jacksonville, are the applicants. They are acting in the interest of Hoffman Miller, of New York, and William D. Barnett, of Jacksonville.

BLOOMINGTON, ILL.—The Springfield & Northeastern Railroad Company, with headquarters at Bloomington, will build an electric railway between Lincoln and Springfield, to cost $600,000. The L. E. Myers Company, Chicago, is the engineer.

BOONVILLE, IND.—The Evansville Suburban & Newburg Railway Company, which has recently changed from steam to electricity, has made an offer to extend the road to Boonville on condition that a franchise be given and right of way be secured. The road will still retain steam as a motive power for freight service.

MISSOULA, MONT.—The City Council has called a special election to be held in March to decide upon the granting of a franchise for an electric railway in this city. J. R. Wharton, of Butte, representing Senator William A. Clark, is the applicant.

WESTFIELD, N. J.—The Corry, Findley Lake & Northeast Railway has been incorporated. The capital stock is $130,000, and the directors are C. P. Northrup, Warren, Pa.; M. H. Raymond, Corry, Pa., and Ross Knight, Westfield, N. J.

TRENTON, N. J.—The New Orange Four Junction Railroad and the Rahway Valley Railroad Company have filed joint agreement with a capital stock of $300,000. The directors and William W. Cole, Louis Kellar, H. F. Dunkel, E. G. Thompson, G. B. Frost, C. J. Wittenberg, James S Gilbert and W. I. Scott.

AUBURN, N. Y.—The State Board of Railroad Commissioners has granted the application of the Auburn & Northern Electric Railroad for a certificate to construct a 9-mile double track road from Auburn to Port Byron.

ELMIRA, N. Y.—The Chemung Valley Traction Company, organized at Elmira, N. Y., has been incorporated with a capital of $700,000 to operate an electric railway 18½ miles long, from Elmira to Waverly, Tioga County. The directors are E. E. Buchanan, Boyd McDowell and George McCann, Elmira.

ALBANY, N. Y.—The Bronx, Yonkers & White Plains Railway Company has been incorporated with a capital stock of $110,000 to construct an electric road 11 miles long from Yonkers to White Plains to connect with the Harlem Division of the New York Central Railroad. The directors are W. H. Whittaker, J. H. Matthews, G. A. Matthews, W. C. Shires, New York; F. S. Fisher, E. M. Booth, Patrick McCann, Nathan Fernhacker and I. M Hunt, White Plains.

DALLAS, N. C.—The town of Dallas has requested the State Legislature for permission to issue $5000 in bonds for the construction of an electric lighting plant.

CINCINNATI, OHIO.—The Ohio River & Columbus Railway Company is planning to extend its line from Ripley to Aberdeen next summer.

ZANESVILLE, OHIO.—The Southeastern Ohio Railway, Light & Power Company has been granted a franchise in Zanesville over the route desired for entrance to the city.

LEBANON, OHIO.—The Miami Transit, Light & Power Company has increased its capital to $600,000. The line will complete a second all-electric route from Cincinnati to Springfield.

NORFOLK, VA.—The Norfolk Railway & Light Company is endeavoring to secure a franchise to build an electric railway to Elizabeth City, N. C., from Norfolk.

TACOMA, WASH.—An electric railway between this city and Olympia, a distance of 17 miles, is under contemplation. A. Bettes, of Spokane, is the promotor.

SPOKANE, WASH.—The Chehalis & Eastern Railroad Company has been incorporated at Olympia, Wash., with a capital of $2,000,000 to build an electric railway from Chehalis, Wash., to Sulphur Springs, about 75 miles. The incorporators are Francis Donohue, C. O. Gingrich, John T. Coleman, T. C. Rush, Louis J. Sitcklin, Dan W. Rush, U. E. Harmon and Charles W. Taylor. It will tap a rich timber, mineral and farming section.

New Industrial Companies.

THE INTERNATIONAL IGNITION COMPANY, of Cleveland, Ohio, has been incorporated with $25,000 capital.

THE CLARK ELECTRIC METER COMPANY has been organized at Chicago, Ill., by Eugene J. Clark, Frank W. Roberts and Max A. Gorman.

THE STANDARD LIGHT MANUFACTURING COMPANY, of Boston, has been incorporated, capital $30,000. President, George A. Parmenter; treasurer, Reuben A. Beard.

THE NATIONAL SCHOOL OF TELEGRAPHY has been incorporated with headquarters in Green Castle, Ind. The incorporators are Wm. W. Ray, L. E. Bailey and W. L. Williamson.

THE BRENNAN ELECTRIC CONSTRUCTION COMPANY, of Chicago, has been formed with $5000 capital, for manufacturing purposes. Incorporators: W. F. Brennan, J. P. Early and D. F. Cleary.

THE BAKER ELECTRIC COMPANY, of Hartford, Conn., has been incorporated. Foster E. Harvey, Robert H. Lewis and Burton E. Baker are the incorporators. Its authorized capital stock is $50,000.

THE ELECTRIC, HEAT & EQUIPMENT COMPANY has been incorporated in Jersey City, N. J., with a capital stock of $100,000. The incorporators are Louis B. Dailey, H. O. Coughlan and T. F. Barrett.

THE INTERURBAN ELECTRIC CONSTRUCTION COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000. The incorporators are J. J. Read, Dewitt V. D. Reily, Kenneth K. McLaren.

THE AMERICAN BATTERY COMPANY, of Milwaukee, has been formed to manufacture electric batteries and other mechanical appliances and instruments; capital, $25,000. Incorporators: Louis Axelsen, Christen Christensen, and Arnold Gabrielson.

THE CALIFORNIA-NEVADA MINING & MILL COMPANY has been incorporated in Arizona, with a capitalization of $5,000,000, to develop power on Big Pine and Lone Pine creeks, California, 76 miles from Goldfield. The incorporators are Hon. Geo. S. Nixon, Pierce Evans, of Reno; John S. Cook, H. T. Bragdon, R. L. Johns and Frank V. Drake.

THE ELECTRIC BOND & SHARE COMPANY, of Schenectady, N. Y., has been incorporated with a capital stock of $4,000,000. It will construct roads, tramways and railroads, and hydraulic, electric and gas plants. The directors are Hinsdill Parsons, Schenectady; Marsden J. Perry, Providence, R. I.; Philip L. Saltonstall, Boston; Jacob K. Newman, New Orleans, and Charles A. Coffin, New York.

Legal.

SERIES ALTERNATING-CURRENT ARC LIGHT REGULATOR.—On Feb. 6, Judge Archibald, of the United States Circuit Court for the Eastern District of Pennsylvania, handed down a decision in a suit against the Helios-Upton Company for infringement of two patents issued to Malcolm H. Baker, relating to method and means of maintaining a constant current in a series alternating current circuit operated from a high potential main. The court held that the method was invalid, owing to the claims being so drawn as to apparently claim a principle, but it sustained a claim on the patent for apparatus. This claim covers an alternating circuit with a series of translating devices having a regulating reactance coil with the moving part adapted, when moved to different positions by the magnetic pull of the coil, to cause varying choking effects, the said moving part being acted upon by a force opposing the magnetic pull, which force is so adjusted throughout its effective range of operation as to counterbalance the magnetic pull when the moving part is in such positions with respect to the coil as are adapted to produce constant current. The court held that there was substantial equivalency in both form and function of the Helios-Upton and the Baker regulator. A decree of infringement was ordered.

COMMON BATTERY AUTOMATIC SIGNALING BOARDS.—Judge Seaman, of the United States Circuit Court for the Southern Division of the Northern District of Illinois, has handed down a decision dismissing a blll in a suit instituted by the Western Electric Company against the Galesburg Union Telephone Company and Howard Knowles, for alleged infringement of a patent issued March 12, 1901, to Charles E. Scribner for apparatus for telephone switchboards. The patent is one of a series of three granted to C. E. Scribner, all relating to a signaling system for telephone exchanges, and claimed to cover in great part the common battery automatic signaling board. The court decided that the patent in suit comes under the rule against double patenting, since the means and system of the patent are plainly embodied as an entirety in another patent. The court also held that the defense of non-infringement is well asserted under the interpretation which must be given to the claims of the patent, since it plainly appears that signalling and tests in the prior art had progressed to the extent of furnishing both audible and visible tests at the telephone exchange prior to the invention in suit. The supervisory lamp of the defendant's device was not adapted to be lighted by the full current through the resistance there provided, and was not there so lighted; and the particular function of the patentee's resistance coil is not performed by the resistance used by the defendant's. The feature of the complainant's structure in which invention is found, is the introduction of a resistance coil for a special function in the system, and the invention is thus of narrow scope and must be limited accordingly so that the prior art may remain free.

COMPANIES MAY CONSOLIDATE.—The Missouri-Edison and Union electric light and power companies had a legal right to consolidate, according to a decision rendered by Judge Pollock in the United States Circuit Court Feb. 23. The opinion was given on a demurrer presented by the attorneys for the companies in the suit of Morgan Jones against the Missouri-Edison electric light and power company and its directors, in which he sought to prevent the company from consolidating with the Union company. Jones was a stockholder in the Missouri-Edison Company, and tried to prevent it from consolidating with the Union Company, but a merger was effected September 9, 1903. Mr. Jones also asked for an accounting of the property of the Missouri-Edison Company and an equable division of the stock and for a receiver to take charge of the property. The petitioners alleged that the basis of consolidation was one share of consolidated Union stock and $5 for two shares of preferred stock in the Edison Company, and one share of Union stock and $5 in exchange for four shares of common stock in the Edison Company. The petitioner also alleged that the Missouri-Edison Company was a paying concern; that it had no reason for consolidating, and that the "combine" was against the anti-trust laws. He also held that the Union Company was overstocked, and that it was capitalized at a figure above its value. The decision practically ends the case, unless an appeal be taken. Judge Pollock said: "The State has unqualifiedly and without limitation granted the power of consolidation to any two corporations where the objects and business are in general of the same nature, as were the objects and business of the Edison and Union

companies, the consolidation of which is hereby challenged." The judge said that Mr. Jones bought the stock with the knowledge that corporations of this kind had authority to consolidate at any time.

RIGHT TO FIX TELEPHONE RATES.—The Supreme Court of Ohio has just handed down its decision in the rate litigation of the Toledo Telephone Company, an independent organization. The company filed an application in the City Council, February 23, 1901, asking authority to use the streets of Toledo. Accompanying this request there was presented an ordinance which the Council was asked to pass. This action was not taken, and the management of the company thereupon asked the probate court to determine the mode of the use of the streets by the telephone concern. In July, 1901, the probate court, Judge Millard on the bench, granted the franchise asked for. In it was provided that the company should charge $44 a year for business telephones and $26 a year for those in residences. In September, 1903, the Home Company decided to increase the rates so that $52 a year would be charged for business and $32 for residence. The following November, the city, on relation of John M. Sheets, attorney general, began quo warranto proceedings in supreme court, to oust the company from the privilege of increasing the rates. The city alleged that the telephone company asked the probate court to fix the rate of toll, and that, therefore, it had no right to change them. Voluminous briefs were filed by both sides. Wade Ellis, attorney general, assisted Solicitor Denman in the case. The decision now handed down means that the probate court has not authority to fix rates to be charged by a telephone company. In a similar case, in which the city of Findlay sought to prevent the raising of tolls of the independent telephone company there, the court decided that even the City Council had no right to fix the toll rates. It would thus appear that neither the City Council nor probate court has power to name the amount to be charged by telephone companies in Ohio. The case was argued on the demurrer of the city to the answer of the Home Company. The court overruled the demurrer and dismissed the petition of the city. The decision slip shows that the court was unanimous in the decision. The case is of great importance, because the decision affects every city in Ohio, and, in all probability, all of the United States. The local company is now operating under the increased schedule and is privileged to continue to do so and make additional charges.

Personal.

MR. B. A. SCHRODER, who has been for some time past attached to the St. Louis office of the Crocker-Wheeler Company has now been placed in charge of the New Orleans office. He succeeds at that city Mr. E. P. Field, who has been transferred to the Crocker-Wheeler Boston office.

MR. HUGO REISINGER.—According to a despatch from St. Louis, Mr. Hugo Reisinger, of New York, has been decorated by Emperor William of Germany as officer of the Royal Order of the Crown. Decorations were also conferred upon 16 other Americans who were prominently connected with the St. Louis World's Fair.

MR. W. K. PALMER, consulting engineer, 718 Dwight Building, Kansas City, Mo., has been engaged as engineer for the city in connection with building the new municipal electric lighting plant. Plans and specifications are now being prepared. Mr. Palmer has also secured the contract for engineering services in connection with the municipal electric lighting plant about to be built by the city of Waverly, Kan., in conjunction with the proposed new water works system.

MR. HENRY J. PIERCE, of Buffalo, N. Y., a well-known capitalist and business man of that city, has been elected president of the International Railway Company to succeed Mr. W. Caryl Ely, resigned. In addition to the local enterprises in which he is interested, Mr. Pierce is president of the Netherlands Tramway Company, which runs from Amsterdam to Haarlem, and which was recently described in these columns. He is also a director in the J. G. White Company.

MR. J. C. HENDERSON, well known as a pioneer in the electric lighting field, has been appointed assistant to the president of the United Gas & Electric Company, of New Albany and Jeffersonville, Ind. He will have charge of the construction and the technical operation of the electric light plants of New Albany and Jeffersonville, the New Albany water works, the street railway lines of New Albany and Jeffersonville and the interurban line between the two cities which is now being extended over the Big Four bridge at Jeffersonville to Louisville. Mr. Henderson went to New Albany several months ago to superintend the construction of the traction line to Louisville.

MR. ARTHUR WILLIAMS, whose reports on decorative and sign lighting have attracted such favorable notice at the last two conventions of the National Electric Light Association, has been appointed by President Davis to report on "Municipal Ownership" at the twenty-eighth convention, to be held in Denver-Colorado Springs, June 6 to 11. Mr. Williams has already collected a large amount of statistics regarding the management and operation of municipal plants both in this country and abroad, and with his usual skill and thoroughness will make this report very complete and interesting. It will be a valuable addition to the literature already possessed by the association on this subject.

PROF. W. L. HOOPER, head of the department of electrical engineering at Tufts College, has started on his tour of the world for the purpose of investigating the problem of the protection of high voltage transmission lines from lightning. The leave of absence for the remainder of the year was granted because the problem is one of the most important of those connected with engineering science, and one respecting which comparatively little is known. Prof. Hooper was requested to investigate this by Mr. Frederick S. Pearson, of New York City. He will first examine the literature of the subject, and then visit all the high voltage and long-distance lines in this country and Europe.

BRADY-HAMILTON.—The most notable wedding of the season at Albany, N. Y., took place on March 4 at the home of Mr. and Mrs. Andrew Hamilton when their second daughter, Miss Elizabeth Hamilton, became the bride of James Cox Brady, the second son of Mr. and Mrs. Anthony N. Brady. The Right Rev. T. M. A. Burke, assisted by the Rev. Michael L. Walsh, performed the ceremony. The bridal party consisted of the maid of honor, Miss Hamilton, elder sister of the bride, and three bridesmaids, Miss Marcia Brady, a sister of the bridegroom; Miss Mary Hamilton, a younger sister of the bride, and Miss Mary Lord, of Chicago. Mr. Nicholas F. Brady, the treasurer of the New York Edison Company, was best man.

MR. A. N. BRADY.—It is said to be probable that Anthony N. Brady may accept the presidency of the Consolidated Gas Company which has been vacant since the resignation of Harrison E. Gawtrey. Mr. Brady has for a long time been virtually the operating head of the company, has long been a leading spirit in the People's Gas Company of Chicago, and was one of the organizers of the New Amsterdam Gas Company, which a few years ago was absorbed by the Consolidated Gas Company and since the merger has been a director of the latter company. He is president of the Edison Electric Illuminating Company, the constituent concern of Consolidated Gas which operates the electric lighting end of the business, and is chairman of the board of directors of the King's County Electric Light & Power Company, which dominates the electric lighting business in Brooklyn. Mr. Brady is also interested in many lighting enterprises outside New York City.

Obituary.

DR. ALBERT BENJAMIN PRESCOTT, director of the chemical laboratories of the University of Michigan, professor of organic chemistry, dean of the school of pharmacy, and oldest instructor in the institution in point of years and service, died last week at Ann Arbor, aged 72 years.

MR. DUDLEY B. WICK, JR.—We regret to note the death of Mr. Dudley B. Wick, Jr., at the Lakeside Hospital, Cleveland, Ohio, on March 1, as the result of an attack of grip and its attendant effects. He was the eldest son of Mr. and Mrs. Dudley B. Wick, of Cleveland. He was born July 23, 1876. As a boy he was a student of the university and high schools of Cleveland and graduated from Cascadilla in 1898. He took special courses preparatory to his entering upon the profession of an electrical engineer, at both Case School of Applied Science and Cornell University. A few years ago he became connected with the North Electric Company, the well-known telephone manufacturing concern of Cleveland, and by tireless energy speedily rose from a subordinate position to that of chief of the engineering department. This very responsible position he filled with great success and won a very high place for himself among his business associates, foreshadowing a brilliant career. Mr. Wick was a faithful member of the Second Presbyterian church and a regular attendant upon its services. Last June he was married to Miss Ruth A. Sutphen, daughter of Dr. Paul F. Sutphen. He was ill at the time and arose from a sick bed that the ceremony might be performed. He is greatly missed by his family, friends and professional associates.

MR. F. A. LA ROCHE.—Mr. Frederick Albert La Roche died in the Presbyterian Hospital, New York City, on March 4. He was born in 1859 ,and studied chemistry in New York, taking up the study of engineering later in Philadelphia. He became interested in electrical development and began to make apparatus about 1880. In a few years he had built up a business of considerable scope, which was ultimately organized as the La Roche Electric Works, and was carried on in Philadelphia for some years, making dynamos, lamps, meters, motors, electric launches, etc. He then removed his business to New York and took up also the new industry of automobile manufacture. Of late years his electrical manufacturing was done chiefly in the name of the Empire Electrical Instrument Company. He had been in the hospital for six weeks suffering from cancer of the stomach. He was 43 years old. He leaves a widow. Not long after his arrival in New York he embarked in the automobile trade by establishing a branch house for the firm that made the car he used. This concern he called the American Darracq Company, which was controlled by the F. A. LaRoche Company till the time of his death. It had two establishments in this city and branches in Philadelphia and Washington. Mr. La Roche was a regular competitor in all races and other automobile contests in this section of the country and won many prizes. His most notable feat was performed only last summer, and it has never been equalled. He was the first in this country to make a run of several days and nights duration without the engine of his car stopping. He performed his first test of this sort by a run to Boston and back, and when this bad been equalled by another automobile owner he set out on July 25 to make the trip from New York to St. Louis and back without once stopping the running of his engine. This he succeeded in doing in 15 days 2 hours ,traveling more than 3000 miles, during which he had a number of adventures. The Empire Instrument business has for some time past been virtually under the entire management of the efficient treasurer, Mr. C. J. M. McWilliam, who will carry it on without interruption.

Trade Publications.

STANDARD PANEL BOARDS.—The H. Krantz Manufacturing Company, 160 Seventh St., Brooklyn, N. Y., recently issued Bulletin No. 9, in which are described and illustrated various styles of standard panel boards with fuse connections between busbars and switches. Tables giving the dimensions and prices of the various sizes of the different types are included.

THE CENTRAL ELECTRIC COMPANY is sending out to its trade a very attractive little four-page leaflet, on which it shows cuts of its old building, also the picture of its temporary quarters at 207-209-211 East Jackson Blvd. Some details of the company's recent fire are given, but the most of the space is occupied in thanking the members of the electrical fraternity for their generous support, and in emphasizing the fact that the company again has a complete new stock and is in a position to make shipments with promptness and dispatch.

NORTHERN ELEVATOR MOTORS constitute the subject of Bulletin No. 42, recently issued by the Northern Electrical Manufacturing Company, Madison, Wis. The company has developed two lines of machines for elevator work. For moderate and slow speeds the spherical motor has become popularized, and for high-speed passenger service the "square" motor has been developed. These two types are illustrated and described. The "square" motor is very symmetric in design. Its characteristic is its ability to get under way quickly and attain its maximum speed within a few seconds from the start. The details of both types of machines are also illustrated.

NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., is introducing a novel method of educating the masses in the technical application of direct and alternating-current electricity by means of the "National Electrical Catechisms," which will be issued as a serial giving in the form of questions and answers a maximum amount of information in a very condensed form. This information will be collected from the most recent sources of literature and practical experience, and will be useful, not only to the layman and practical engineer, but also to the technical engineer. No charge whatever will be made for this publication which will be sent to any one sending a postal card giving his name and address.

THE EMERSON ELECTRIC MFG. COMPANY, St. Louis, in bulletin No. 3501, gives data and price list of direct-connected exhaust fans for alternating and direct currents. These fans are self-contained and are easily installed as they do not require any system of piping, and need no support other than the wall through which the air is to be expelled. The motors furnished for alternating current operate on the induction principle without brushes or commutator, and are equipped with an automatic starting device. The direct-current motors are series wound, and are provided with speed regulators of the non-automatic-release type. These motors are entirely enclosed, but have removable shutters permitting ready inspection of brushes and commutator.

ELECTRICAL MEASURING INSTRUMENTS.—The Keystone Electrical Instrument Company, Philadelphia, Pa., in its catalogue No. 12, describes and illustrates a long line of direct-reading instruments for either direct or alternating-current circuits, and in switchboard and portable types. The first portion of the catalogue discusses the patent situation and gives a technical description of the Keystone types of instruments. The remaining portion of the catalogue is divided into six sections, the first section is devoted to portable reading instruments; the second to switchboard instruments on the electro-dynamometer system; the third to switchboard instruments on the electro-magnetic system; the fourth to the Keystone arc-light volt meter, polarity indicator and detector galvanometer. Section five contains dimensional diagrams and sample scales of Keystone switchboard instruments, and in section six instructions are given for the selection, use and care of electrical measuring instruments.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, has just issued circular No. 1097, devoted to type K motors which are direct-conrent, series-wound machines designed for the operation of cranes, hoists and similar apparatus, and for intermittent service in which heavy torque and a wide speed variation are required. These motors represent the latest development, and include the most recent improvements in machinery of this kind. The frames are of the wholly enclosed form, to guard against dirt and moisture, but are so designed that the working parts may be exposed for inspection or adjustment without dismantling. Two types of controllers have been designed for use with type K motors, the face-plate type and the grid-resistance type. These controllers are illustrated and described. A valuable feature of the circular is found in the twenty complete sets of test curves of the corresponding number of different machines which show at a glance what may be expected of the motors. Circular No. 1099, of the same company, deals with type B, bi-polar motors, a description of which was given in our columns Feb. 25.

News of the Trade.

KELLOGG TELEPHONE APPARATUS.—The Kellogg Switchboard & Supply Company, Congress and Green Streets, Chicago, Ill., has issued a notice as to the reduction in price of its common battery and magneto telephone apparatus. The change brings the price of its common battery desk sets down to that of itss wall sets, of equal specifications.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, is having a heavy demand for its "non-interfering" country party line telephones. These instruments are so constructed that the user can call any other station on the line without signalling the central office, or can call the central office without ringing any of the other bells on the line. In addition to the "non-interfering" switch the instruments are equipped with the International well-known "never-pack" transmitter, double pole receiver and long spring switch, powerful generator and bell. They have all connecting wires, binding posts and terminal screws fully concealed and protected to avoid these parts becoming accidentally disconnected, and there are no exposed metal parts that form a part of the circuit at any time, thus avoiding all danger from lightning while using the instrument. These features make them especially adaptable for rural party lines and village exchanges.

LOCKE REGULATOR COMPANY.—Mr. F. S. Palmer, formerly electric engineer for the Consolidated Engine Stop Company, and well known in the electrical trade generally, has recently associated himself with the Locke Regulator Company, Salem, Mass., and is devoting all his energy and skill towards increasing the demand for its automatic engine stop which has been received so favorably since being placed on the market. It looks as if it would meet with the same success with this engine stop as it did with its damper regulator when it appeared on the market. The Locke Regulator Company feels that its stop is perfect both mechanically and electrically, having given considerable attention to the latter feature, recognizing that a perfect stop should be thoroughly trustworthy and reliable. The combined method of wiring and testing used by it in connection with its automatic engine stop and speed limit is one applied to automatic fire alarm work, and earned the highest awards at the World's Fair in Chicago and the Louisiana Purchase Exposition in St. Louis.

TRANSITE ASBESTOS LUMBER, made by the H. W. Johns-Manville Company, 100 William Street, New York City, is strongly recommended on the score of its fireproof qualities. It may be interesting to set forth the results of the tests given to this material by the Shawinigan Water & Power Company, Shawinigan, Quebec. A piece of Transite was taken and boiled in water for 15 minutes; then taken out and again boiled for 10 minutes. The edges turned up or warped very slightly, indicating a minute degree of absorption. It was then subjected in its wet condition to a heat test for 15 minutes over a white hot blast. The material came out whole, excepting for a slight hardening and brittleness, but retaining all its fire-proofing qualities. It was then tested as an arc-deflector on a circuit of 500 volts at 150 amperes. It took 11 minutes of constant arcing to burn a hole through it. This piece was only ¼-inch thick. Transite was tested in conjunction with other boards of a similar character, and was the only one which stood the test, the other, after the boiling test, in the heat test blew up, indicating the presence of much moisture which was absorbed during the boiling process. Besides possessing the acid-proof, steam and moisture proof, fire-resisting, heat insulating and other properties, this board is absolutely vermin-proof, and in this regard its possibilities are unlimited for use in hospitals as a flooring, ceilings, walls, etc. Its non-absorbing qualities will practically eliminate the transfer of disease germs after thorough fumigation. Transite will take a screw or nail the same as wood, and can be sawed, cut, planed or otherwise manipulated to meet the requirements.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 28, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

783,409. FRAME FOR DYNAMO-ELECTRIC MACHINES; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 6, 1903. (See Current News and Notes.)

783,419. TELEPHONY; Edward A. Buell, DeKalb, Ill. App. filed May 2, 1904.

783,430. INSULATING BASE BLOCK FOR ELECTRIC EQUIPMENT; Monroe Guett, Hartford, Conn. App. filed June 13, 1904. A base block which may be used as a single branch block or in connection with another exactly like it, as a double branch block.

783,440. MOUTHPIECE FOR SPEAKING-TUBES OR TELEPHONES; Wilbur R. Kimball, New York, N. Y. App. filed Oct. 17, 1903.

783,458. TROLLEY; James A. Norton, Wilkesbarre, Pa. App. filed Dec. 23, 1904. Details effecting the lubrication and removability of the wheel.

783,462. TIME LIMIT STARTING AND CONTROLLING RHEOSTAT; Robert H. Read and William C. Yates, Schenectady, N. Y. App. filed July 21, 1904. This device enforces on the operator an observance of the proper speed of the rheostat arm, by open-circuiting the retaining magnet of a main circuit breaker, incorporated in the apparatus, if he actuates the arm too slowly.

783,480. STARTING MEANS FOR GAS OR VAPOR ELECTRIC APPARATUS; Percy H. Thomas, Pittsburg, Pa. App. filed Feb. 3, 1903. (See Current News and Notes.)

783,481. STARTING MEANS FOR GAS OR VAPOR ELECTRIC APPARATUS; Percy H. Thomas, Pittsburg, Pa. App. filed Feb. 3, 1903. (See Current News and Notes.)

783,482. SYSTEM OF ELECTRICAL DISTRIBUTION; Percy H. Thomas, Pittsburg, Pa. App. filed Feb. 7, 1903. (See Current News and Notes.)

783,483. ADJUSTABLE VAPOR-DISCHARGE DEVICE; Percy H. Thomas, Pittsburg, Pa. App. filed Feb. 20, 1903. (See Current News and Notes.)

783,495. OSCILLATOR FOR ELECTRIC MACHINES; Edwin C. Wright, Newport, Ky. App. filed May 26, 1902. A magnet is used at the end of the shaft to maintain an oscillation thereof.

783,498. EQUIPOTENTIAL CONNECTIONS FOR ARMATURES FOR DYNAMOS WITH WAVE-WINDING; Engelbert Arnold, Karlsruhe, and Friedel Collischomm, Frankfort-on-the-Main, Germany. App. filed June 8, 1901. Cross connections are made between nodal points of the wave winding; the half number of poles of the winding being greater than the number of bifurcations of the current through sets of armature coils that are in parallel.

783,503. TEMPERATURE COMPENSATING DEVICE FOR THERMO-ELECTRIC MEASURING INSTRUMENTS; William H. Bristol, New York, N. Y. App. filed Dec. 15, 1904. Means for compensating for changes of temperature at the cold or outer ends of a thermo-electric generator.

783,509. ELECTRIC LIGHTING SYSTEM; Albert G. Davis, Schenectady, N. Y. App. filed March 4, 1899. The combination of an illuminant which is non-conducting when cold, means for heating the same to conductance and an automatic source of current supply for furnishing current to the illuminant, the automatic action of said source enables the illuminant to operate with stability.

783,510. TELEPHONE-EXCHANGE SYSTEM; William M. Davis, Chicago, Ill. App. filed May 20, 1903.

783,513. REGULATOR; Richard Fleming, Lynn, Mass. App. filed Sept. 26, 1903. The voltage between supply lines is altered by a pair of coils in inductive relation with each other, one of the coils being in series with the circuit including the supply lines and the other in shunt therewith, and means for varying the inductive relation between these two coils.

783,514. REGULATOR; Richard Fleming, Lynn, Mass. App. filed April 25, 1904. A pair of windings movable with respect to each other, one having portions producing magnetizing forces acting in opposite directions and means for automatically bringing into proximity the other winding and one of the other of said portions in response to changes in the electrical condition of the circuit.

783,526. ADJUSTABLE SUPPORT FOR ELECTRIC LIGHTS OR THE LIKE; Charles D. Kemmerer, Weissport, Pa. App. filed Oct. 25, 1902. Details.

783,532. TRANSFORMER; Walter S. Moody, Schenectady, N. Y. App. filed July 21, 1904. A heating coil is located in the lower portion of a fluid-cooled electrical apparatus for drying purposes.

783,533. TRANSFORMER PROTECTION; Walter S. Moody, Schenectady, N. Y. App. filed July 25, 1904. The secondary is connected to the core of the transformer and the core is grounded through a heavy connection for safety purposes.

783,537. MOTOR CONTROLLER; William A. McTaggart, Schenectady, N. Y. App. filed Aug. 15, 1904. The controller is provided with an arc deflecting section comprising a thin plate having laterally projecting spacing bosses.

783,543. ELECTRIC CHAIN WELDING MACHINE; Adolph F. Rietzel, Lynn, Mass. App. filed Oct. 15, 1903. Besides various mechanical features, the invention comprising means for applying the heating current brought into engagement with the work by movement in the lateral direction, or transversely to the line of operation of the work holders.

783,546. INSULATION FOR EDGEWISE WOUND COILS; George H. Rupley, Schenectady, N. Y. App. filed July 21, 1904. Insulation consisting of a strip of paper folded lengthwise along the middle and the conductor resting along the bottom of the same.

783,604. ART OF TELEGRAPHY; Marcus O. Anthony, Barberton, Ohio. App. filed May 10, 1902. A system in which induction coils are located between the local and main circuits.

783,612. ELECTRIC SWITCH; Percy L. Clark, Bristol, Conn. App. filed June 23, 1904. A tilting hollow vessel containing electrodes and a globule of mercury with a small quantity of oil to take up foreign particles created by the excessive arcs.

783,645. ELECTRIC LAMP AND SOCKET; Charles G. Perkins, Hartford, Conn. App. filed July 30, 1904. When the lamp is screwed into the socket it becomes locked and requires the use of a key to remove it.

783,651. TRANSFORMER FOR ELECTRIC METAL-WORKING APPARATUS; Elihu Thomson, Swampscott, Mass. App. filed Dec. 4, 1903. The primary coil has its terminals connected with two wires of a polyphase system, while the third wire is connected at an intermediate portion of the winding; the secondary is subject to the conjoint action of the sections of the primary coil carrying the out-of-phase currents, so as to be the seat of single-phase currents.

783,652. ELECTRIC SWITCH CONTACT; William C. Tregoning, Hartford, Conn. App. filed May 24, 1904. The two spring contacts to receive the blade of the switch are formed with holes at one side which pass over the end of a post, the post being then headed over to hold them in position.

783,653. ELECTRICAL PLUG-CUT-OUT COVER; William C. Thegoning, Hartford, Conn. App. filed June 13, 1904. Shutters are arranged behind the cover to close the plug openings that can be swung to one side by inserting and rotating a key.

783,666. REVOLVING PLATE FOR STATIC MACHINES; Burton E. Baker, Hartford, Conn. App. filed Dec. 31, 1904. A plate is built up of alternate layers of fibrous material and shellac united into a homogeneous mass.

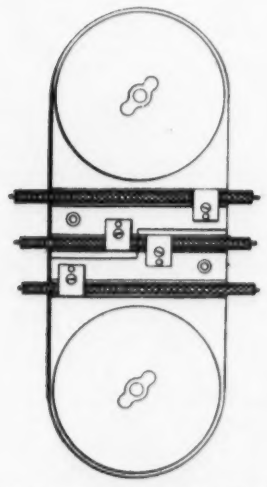
783,687. ELECTRIC RAILWAY; Alfredo Diatto, Turin, Italy. App. filed Nov. 20, 1902. A blow-out magnet is arranged to protect the contacts of the section switches from arcs.

783,696. INDICATING LEAKS IN ELECTRIC CONDUCTORS; Isidor Kitsee, Philadelphia, Pa. App. filed June 5, 1902. The device registers the occurrence of a leak and the time a leak exists, and automatically gives warning of the existence of the leak.

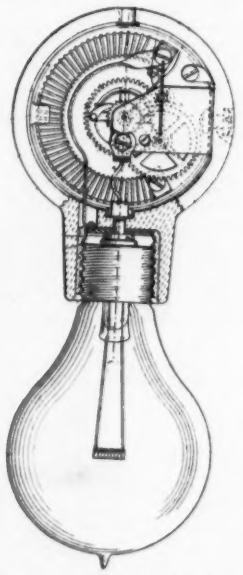
783,708. GENERATING LOW-FREQUENCY CURRENTS; William Stanley, Great Barrington, Mass. App. filed Nov. 11, 1903. (See Current News and Notes.)

783,712. APPARATUS FOR RECEIVING ELECTROMAGNETIC WAVES OR OTHER FEEBLE ALTERNATING SIGNAL IMPULSES; Frederick K. Vreeland, Montclair, N. J. App. filed Nov. 12, 1904. Two electrolytic cells having minute annodes, means for polarizing the cells, means for passing the half waves of the signal impulses through the cells alternately and in opposition to the polarizing currents, thereby polarizing the cells and means for observing the polarization.

783,715. CIRCUIT CONTROLLER; Rollin A. Baldwin, New Haven, Conn.



783,430.—Insulating Base Block for Electric Equipment.



783,509.—Electric Lighting System.

App. filed Sept. 29, 1904. A shoe or frame applied to the control wire and through which the wire runs, the control passing over the exterior surface of the shoe and in contact with a metal face thereon, so that current will for the instant be drawn through the branch circuit for operating switches or signals.

783,733. ELECTRICAL MEASURING INSTRUMENT; Weston A. Price, Cleveland, Ohio. App. filed Feb. 24, 1903. A highly sensituve instrument responsive to exceedingly small currents and comprising certain details of construction.

783,737. ELECTRIC CANDLEABRUM; Charles E. Weeks, Providence, R. I. App. filed June 30, 1903. Details permitting the insertion of the socket of a small lamp into an imitation candle.

783,742. BALANCED CORD DROP ATTACHMENT; Henry D'Olier, Jr., Philadelphia, Pa. App. filed March 8, 1904. A goose-neck is supported at the lower end of the cord and carries the lamp in a horizontal position.

783,746. ELECTRIC SECONDARY CLOCK; Fred I. Getty, Chicago, Ill. App. filed May 26, 1902. Details.

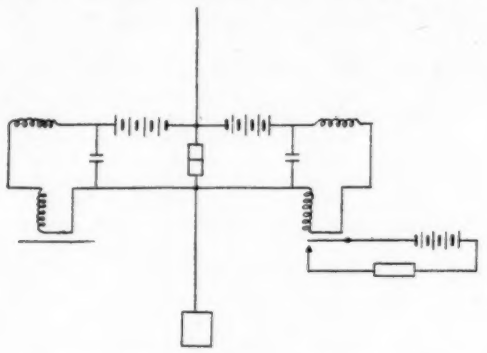
783,751. INSULATED RAILWAY RAIL JOINT; Edward D. Lewis, Syosset, N. Y. App. filed June 1, 1904. Details.

783,802. INDUCTION COIL; Harry Shoemaker, Jersey City, N. J. App. filed Sept. 1, 1904. The parts are disposed and arranged so that they are easily portable and assembled and connected for use.

783,861. TELEPHONE-SWITCH; Albert W. Hammer, Willow, Ind. App. filed Jan. 25, 1904.

783,876. SYSTEM OF ELECTRIC LIGHTING; John Lindall, Boston, Mass. App. filed Oct. 17, 1904. The lamps are arranged in series on a high potential circuit and each has a thermostatic fuse which will interrupt the circuit in case an arc is formed in any of the lamps.

783,911. ELECTRIC PUSH SWITCH; George B. Thomas, Bridgeport, Conn. App. filed June 13, 1904. A double push switch actuated by the insertion



783,992.—Wireless Telegraphy by Electric Waves.

of a key in one or two keyholes and provided with means to indicate into which hole the key is to be inserted.

783,923. WIRELESS TELEGRAPHY BY ELECTRIC WAVES; André Blondel, Paris, France. App. filed Dec. 3, 1900. A receiving station containing an acoustically tuned electro-magnetic receiver, selectively actuated in accordance with a different group frequency of waves absorbed at the station.

783,965. COMMUTATOR; Hermann A. Knoener, East Orange, N. J. App. filed July 25, 1904. Details of construction of a cylindrical commutator.

783,974. ELECTRIC ARC LAMP; Charles A. Nagel, Allegheny, Pa. App. filed April 14, 1904. Details.

783,977. ELECTRIC SWITCH; William H. Powell, East Orange, N. J. App. filed Nov. 28, 1903. A number of switch arms arranged in the same plane around the center, with fixed contacts positioned with respect thereto so that different groups of connections will be made at each frictional movement of the central shaft upon which the arms are carried.

783,978. ELECTRIC SWITCH; William H. Powell, East Orange, N. J. App. filed Nov. 30, 1903. Details of a skeleton controller drum.

783,979. RHEOSTAT; William H. Powell, East Orange, N. J. App. filed Oct. 24, 1904. Contact blocks project from the side face of a resistance coil and successively receive the contact of the swinging arm.

783,980. ELECTRIC SWITCH; William H. Powell, East Orange, N. J. App. filed Oct. 24, 1904. A switch drum comprising side rods and a series of contact rings, each of which is clamped on both of the side rods.

783,981. ELECTRIC SWITCH; William H. Powell, East Orange, N. J. App. filed Oct. 24, 1904. To avoid excessive length of the drum, the contact fingers are placed in two rows arranged along diametrically opposite elements of the drum, the contacts being so disposed that connection will be made with all of the fingers in the same order by movement of the drum in either direction from a middle off position.

783,988. COMMUTATION OF DIRECT-CURRENT DYNAMO-ELECTRIC MACHINES; Frederick Wm. Young, Ampere, N. J. App. filed April 17, 1902. (See Current News and Notes.)

783,989. APPARATUS FOR THE COMMUTATION OF DIRECT-CURRENT DYNAMO-ELECTRIC MACHINES; Frederick Wm. Young, Ampere, N. J. App. filed April 17, 1902. (See Current News and Notes.)

783,992. WIRELESS TELEGRAPHY BY ELECTRIC WAVES; André Blondel, Paris, France. App. filed July 7, 1903. The main feature is to mechanically tune the receiving apparatus in unison with the frequency of groups of electro-magnetic waves sent from the transmitting station.

783,995. TEST PLUG FOR PROTECTIVE APPARATUS; Frank B. Book, Chicago, Ill. App. filed April 11, 1904. The different circuits through the apparatus may be readily tested without removing any of the protective devices from their circuits.

783,996. BURGLAR OR FIRE ALARM SYSTEM; John W. Culp, Elkhart, Ind. App. filed June 25, 1904. Details.

783,997. ELECTRIC SWITCH; Edwin R. Douglas, East Orange, N. J. App. filed Nov. 30, 1903. Circumferential tongues and grooves and keys are used to accurately position the contact plates upon the drum of a controller.

783,999. APPARATUS FOR THE COMMUTATION OF DIRECT CURRENT DYNAMO-ELECTRIC MACHINES; Gano S. Dunn, Ampere, N. J. App. filed May 7, 1902. (See Current News and Notes.)

784,000. COMMUTATION OF DIRECT-CURRENT DYNAMO-ELECTRIC MACHINES; Gano S. Dunn, Ampere, N. J. App. filed May 7, 1902. (See Current News and Notes).

784,001. ELECTRIC SWITCH OPERATING MECHANISM; Frederick H. Gray, Leavenworth, Kan. App. filed March 12, 1904. The car wheel strikes a tilting bar adjacent to the rail to actuate an electric switch.

784,006. TURN BUTTON FOR ELECTRIC SWITCHES; Ellsworth A. La Har, New Britain, Conn. App. filed May 24, 1904. Details.

784,009. GOVERNING CONTINUOUS CURRENT MOTORS; Gaston Sautter, Paris, France. App. filed Aug. 23, 1904. A starting rheostat and a braking rheostat are each arranged in sections and electro-magnetic switches are arranged to successively cut-out the sections at the proper time.

784,013. METHOD OF GENERATING LOW-FREQUENCY CURRENTS; William Stanley, Great Barrington, Mass. App. filed Nov. 11, 1903. (See Current News and Notes.)

784,016. SYSTEM OF ELECTRICAL DISTRIBUTION; Percy H. Thomas, Pittsburg, Pa. App. filed May 6, 1903. The desired energy is obtained by inducing into the circuit between the source and the point of utilization devices, by means of which the moment of starting can be predetermined and the proper portions of the successive cycles of current selected.